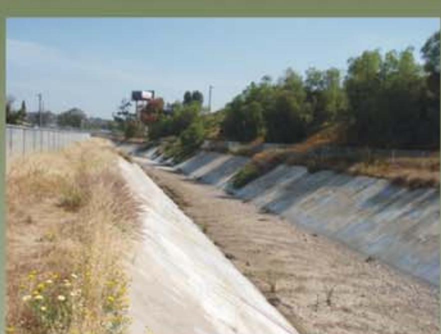
# Chollas Creek Total Maximum Daily Load (TMDL) 2009 - 2010 Water Quality Compliance Monitoring

Prepared for:
San Diego Regional
Water Quality Control Board

**Final Report**
**November 8, 2010**



City of San Diego

San Diego Unified Port District

City of La Mesa

United States Navy

City of Lemon Grove

County of San Diego

CalTrans

# Chollas Creek Total Maximum Daily Load 2009–2010 Water Quality Compliance Monitoring

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# LIST OF ACRONYMS

| | |
|---|---|
| BMP | best management practice |
| COC | chain of custody |
| CTR | California Toxics Rule |
| DWM | dry weather monitoring |
| ICID | illicit connection and illegal discharge |
| JURMP | Jurisdictional Urban Runoff Management Plan |
| MLS | mass loading station |
| NPDES | National Pollutant Discharge Elimination System |
| PAH | polycyclic aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| REC-1 | contact water recreation beneficial use |
| REC-2 | non-contact water recreation beneficial use |
| SOP | standard operating procedure |
| TIE | toxicity identification evaluation |
| TMDL | total maximum daily load |
| WARM | warm freshwater habitat beneficial use |
| WILD | wildlife habitat beneficial use |
| WLA | waste load allocation |
| WURMP | Watershed Urban Runoff Management Plan |

# EXECUTIVE SUMMARY

This report summarizes the monitoring activities conducted by the seven Chollas Creek Dischargers in compliance with the *Total Maximum Daily Loads* (TMDLs) *for Dissolved Copper*, *Lead*, *and Zinc in Chollas Creek*, *Tributary to San Diego Bay* for Compliance Schedule Year 2 (2009–2010 Monitoring Season). In accordance with the TMDL (State Board Resolution No. 2008-0054 and Investigation Order No. R9-2004-0277), wet weather water quality monitoring at SD8(1) in the north fork of Chollas Creek and at DPR2 in the south fork of Chollas Creek was conducted for the following analytes:

- Total and dissolved metals (i.e., copper, lead, and zinc) and total hardness.
- Organophosphate pesticides (i.e., Diazinon, Chlorpyrifos, and Malathion).
- Toxicity to *Ceriodaphnia dubia.*
- Chlorinated pesticides (Chlordane), Polychlorinated biphenyls (PCBs), and Polycyclic aromatic hydrocarbons (PAHs).

**Summary of Wet Weather Monitoring**

Storm water monitoring samples were collected at two mass loading stations (MLS) (i.e., SD8(1) and DPR2) in the Chollas Creek Watershed. Monitoring was conducted during the first and second storm events after October 1, 2009, and the first event after February 1, 2010. During Compliance Schedule Year 2, wet weather monitoring was conducted November 28, 2009 through November 29, 2009; December 7, 2009; and February 6, 2010.

Dissolved copper concentrations at SD8(1) and DPR2 were greater than the acute waste load allocations (WLAs) for the first two storms after October 1, 2009. Dissolved copper concentrations were above the chronic WLA for all three monitored storm events. Dissolved lead was below the acute WLA for both SD8(1) and DPR2. However, dissolved lead was above the chronic WLA during the first and second storms monitored at both sites. Dissolved zinc was above the acute WLA at SD8(1) during the first two monitoring events. Dissolved zinc was below the chronic WLA during all events at DPR2 and during the February 6, 2010 storm at SD8(1).

Like the storm-specific data, the Mann-Kendall trend analyses indicate significantly increasing trends for total and dissolved copper and total and dissolved zinc in the north fork of Chollas Creek (SD8(1)). When compared to historical data (1994–2010), increasing trends are relatively shallow and have flattened over time. However, exceedance ratios have steadily decreased at SD8(1) since 2007. Significantly increasing trends were also noted for total copper and total zinc at DPR2.

While the organophosphate pesticides Diazinon and Malathion were detected during the 2009–2010 Monitoring Season, concentrations were generally low. Diazinon was below the chronic WLA during all events at both sites. Significantly decreasing trends were observed for Diazinon in both the north fork and south fork. For Diazinon, non-detect results are frequently noted. As the residual supply of Diazinon becomes exhausted due to the United States Environmental Protection Agency (USEPA) ban on Diazinon, concentrations and the frequency of detection in Chollas Creek should continue to decrease.

There was only one instance of reproductive toxicity to *C. dubia*, noted at SD8(1), during the first storm event on November 29, 2009. This was the first storm event following approximately 279 dry days without significant rainfall. Pollutant buildup during this long dry weather period may have contributed to the toxic effects observed during the first flush storm event.

**Recommendations**

Based on the TMDL compliance monitoring results from the 2009–2010 Monitoring Season, the following program changes/additions are recommended:

- Continue monitoring to evaluate compliance with the Chollas Creek Diazinon and Dissolved Copper, Lead, and Zinc TMDLs and to assess trends in monitoring data.
- Evaluate the results from the City of San Diego Water-Effect Ratio study, a final report is anticipated in 2012.
- Future monitoring should include the additional analytes necessary to evaluate metals toxicity using the biotic ligand model. This data will provide additional support to the Water-Effect Ratio study results.
- Re-evaluate the dissolved lead TMDL WLA in the anticipated release of the draft USEPA revised lead criteria.

**Ongoing TMDL Implementation**

The Chollas Creek TMDL Implementation Plan (Implementation Plan) (City of San Diego and Weston, 2009a) was specifically prepared in response to Resolution No. R9-2007-0043 in which the Regional Board incorporated the TMDL for dissolved copper, lead, and zinc into the Basin Plan. The Implementation Plan uses an iterative and adaptive management strategy for identifying, planning, implementing, and assessing best management practices (BMPs) for the Chollas Creek Watershed over the 20-year compliance schedule. The Implementation Plan was submitted to the Regional Board on October 21, 2009. The seven named TMDL Dischargers—which include the five Chollas Creek Watershed Municipal Copermittees, United States (US) Navy, and California Department of Transportation (Caltrans)—will use the Implementation Plan as a framework for ongoing compliance.

# 1.0 INTRODUCTION

This report summarizes the monitoring activities conducted by the seven Chollas Creek Dischargers in compliance with the *Total Maximum Daily Loads (TMDLs) for Dissolved Copper*, *Lead and Zinc in Chollas Creek*, *Tributary to San Diego Bay* (Chollas Creek Dissolved Metals TMDL) for Compliance Monitoring Schedule Year 2 (2009–2010 Monitoring Season). In accordance with the TMDL (State Board Resolution No. 2008-0054 and Investigation Order No. R9-2004-0277) wet weather water quality monitoring at SD8(1) in the north fork of Chollas Creek and at DPR2 in the south fork of Chollas Creek was conducted for the following analytes:

- Total and dissolved metals (i.e., copper, lead, and zinc) and total hardness.
- Organophosphate pesticides (i.e., Diazinon).
- Toxicity to *Ceriodaphnia dubia.*
- Chlorinated pesticides (Chlordane), Polychlorinated biphenyls (PCBs), and Polycyclic aromatic hydrocarbons (PAHs).

The Chollas Creek Watershed encompasses approximately 18,144 acres of predominately urbanized land located within San Diego County. The Chollas Creek Watershed is located southeast of downtown San Diego, in the San Diego Mesa Hydrologic Area, and within the larger Pueblo San Diego Hydrologic Unit. Though much of the creek has been channelized, there have been efforts to restore natural flow in the watershed. The creek is ephemeral in nature, flowing primarily during the wet season and typically only during storm events.

Chollas Creek consists of two main tributaries, the north fork and the south fork. The drainage area of the northern fork (i.e., 8,794 acres) of the watershed is larger than that of the southern fork (i.e., 7,575 acres). The headwaters of the north fork originate approximately 1.5 miles west of the jurisdictional boundary of the City of La Mesa. From this point, the north fork flows in a southwesterly direction for approximately 3 miles before it is joined by several smaller tributaries, which feed into the mainstem of the creek. The creek then flows in a southerly direction for approximately 1.5 miles before discharging into San Diego Bay. The south fork of Chollas Creek flows in a west–southwesterly direction from its headwaters in the City of Lemon Grove and is the product of two smaller creek branches. The north fork and south fork merge approximately 0.8 mile east of the creek's mouth, near the upper extent of the tidal influence from San Diego Bay. An aerial representation of the Chollas Creek Watershed is shown on Figure 1-1.

The Chollas Creek Watershed is highly urbanized. Land use in the Chollas Creek Watershed is predominantly residential (48%), roads (22%), and freeways and highways (5%), as shown on Figure 1-2. The remaining watershed land uses consist of commercial and industrial and landfills (7%), open space / parks and recreation (7%), schools (3.5%), cemeteries (1.5%), and other miscellaneous land uses.

The seven Dischargers named in the 2007 Chollas Creek Dissolved Metals TMDL participating in compliance monitoring include California Department of Transportation (Caltrans), the United States Navy (Navy), and five of the San Diego Region Municipal Stormwater Copermittees (Regional Board Order No. R9-2007-0001). As summarized in Table 1-1, the five Copermittees included as Dischargers are the City of La Mesa, City of Lemon Grove, City of San Diego, County of San Diego, and Unified Port District of San Diego. The jurisdictional boundaries of the seven Dischargers are shown on Figure 1-1. Approximately 3.5% of the Chollas Creek Watershed is under the jurisdiction of other agencies not named in the Chollas Creek Dissolved Metals TMDL.

**Table 1-1. Dischargers Named in the Chollas Creek Dissolved Metals Total Maximum Daily Load**

| TMDL | San Diego Region Municipal Storm Water Copermittees | Dischargers |
|---|---|---|
| Chollas Creek Dissolved Metals TMDL | City of San Diego<br>City of La Mesa<br>City of Lemon Grove<br>County of San Diego<br>Unified Port District of San Diego | Caltrans<br>City of San Diego<br>City of La Mesa<br>City of Lemon Grove<br>County of San Diego<br>Unified Port District of San Diego<br>Navy |

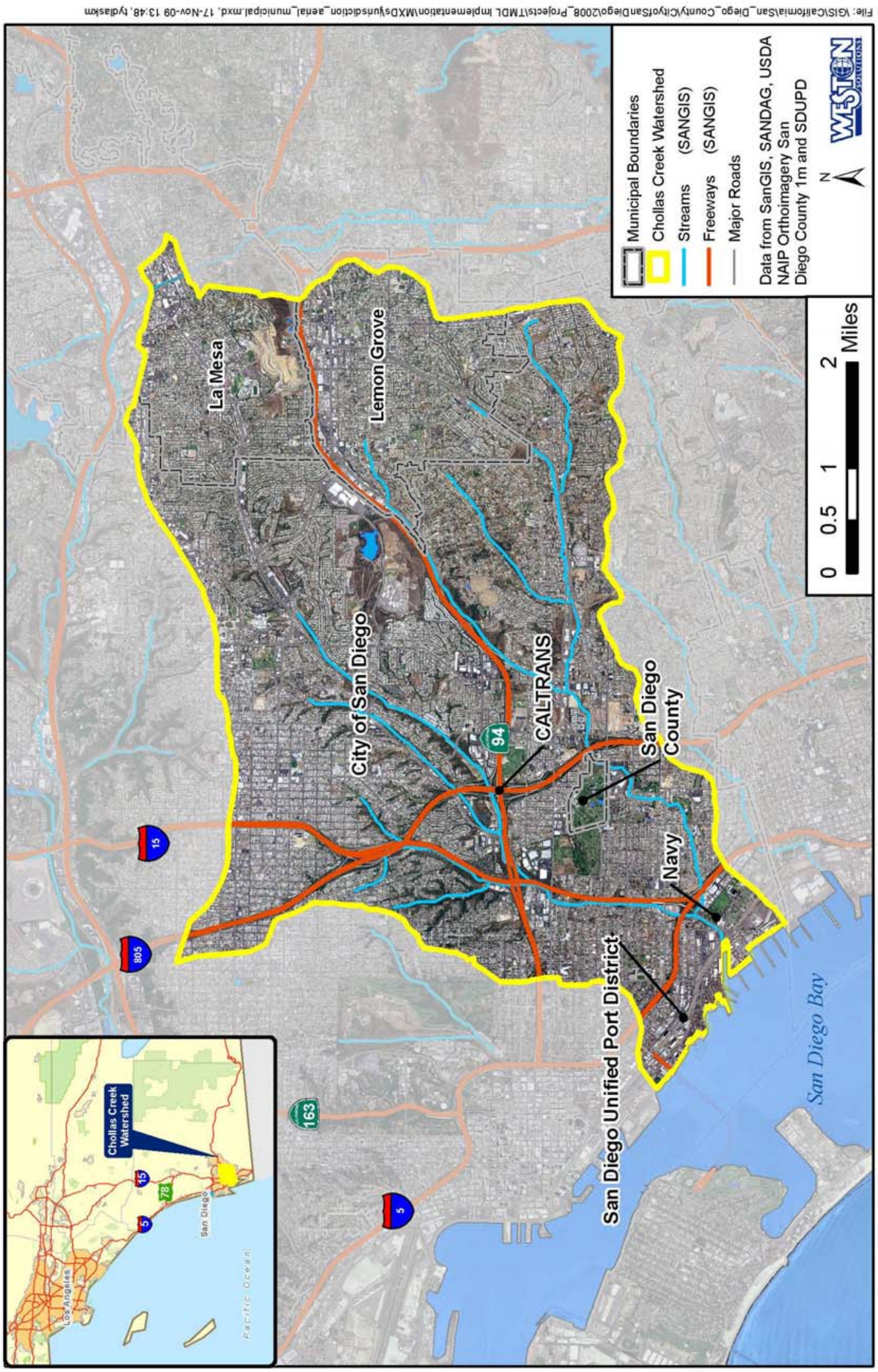



**Figure 1-1. Aerial View of the Chollas Creek Watershed**

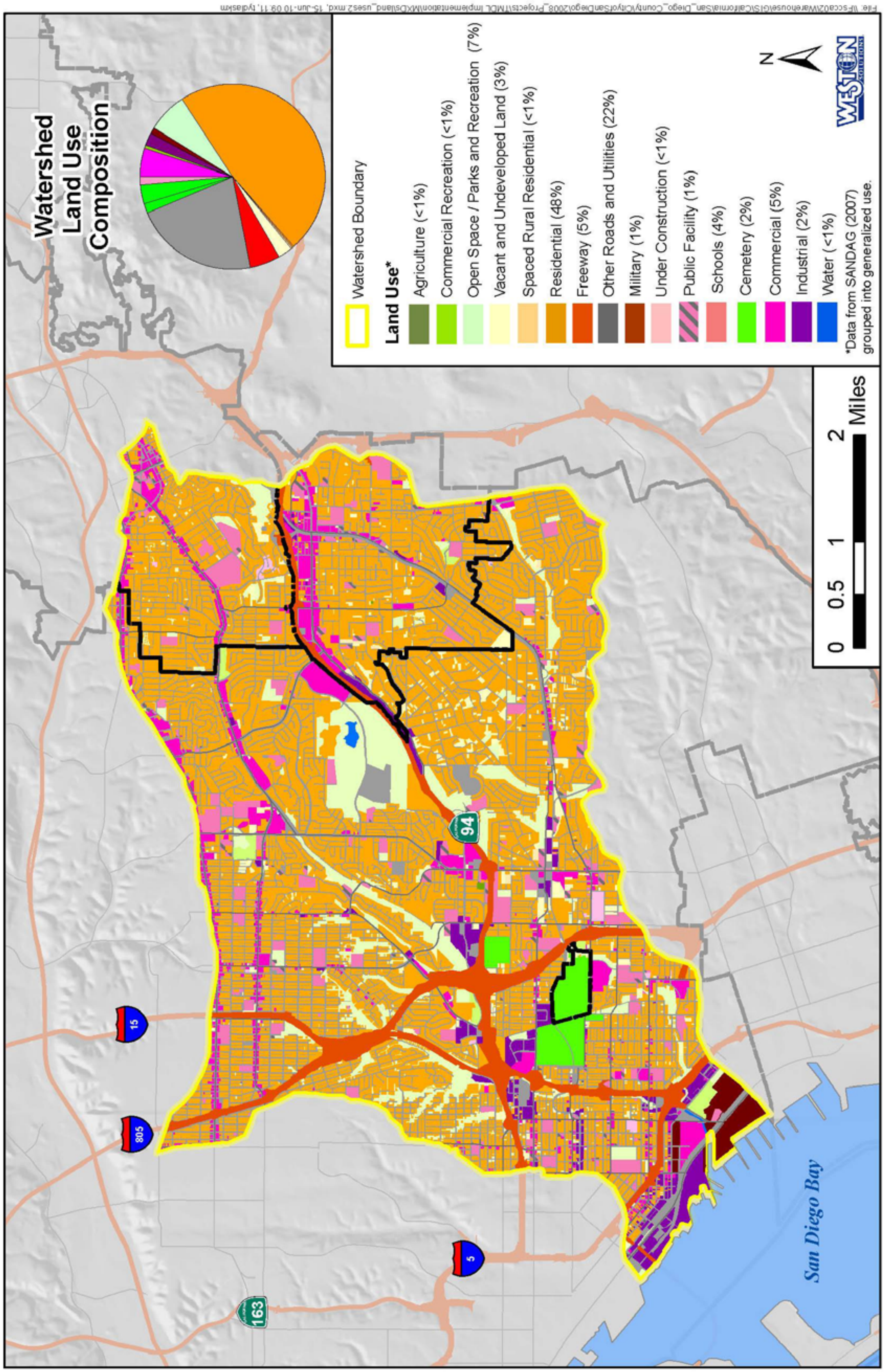



**Figure 1-2. Land Uses within the Chollas Creek Watershed**

## 1.1 State Water Resources Control Board Section 303(d) Listings and Total Maximum Daily Load Overview

The Water Quality Control Plan for the San Diego Region (Basin Plan) lists the inland surface water beneficial uses of Chollas Creek as non-contact water recreation (REC-2), warm freshwater habitat (WARM), and wildlife habitat (WILD). Chollas Creek also has the potential to support a contact water recreation (REC-1) beneficial use. The 2006 Clean Water Act (CWA) State Water Resources Control Board (State Board) Section (§)303(d) List identifies dissolved copper, dissolved lead, dissolved zinc, and indicator bacteria as pollutants that impair Chollas Creek. Diazinon appeared on the State Board §303(d) list in 1999 but was removed in 2006 after the *Chollas Creek TMDL for Diazinon* (Diazinon TMDL) was adopted. Table 1-2 summarizes the State Board §303(d) listings and beneficial uses for Chollas Creek above the tidal prism (corresponding to the two branches of the creek).

**Table 1-2. Beneficial Uses and State Water Resources Control Board Section 303(d) Listings in the Chollas Creek Watershed**

| Beneficial Uses | Chollas Creek (3.5 miles) | Chollas Creek §303(d) Pollutants | San Diego Bay | San Diego Bay §303(d) Pollutants |
|---|---|---|---|---|
| REC-1 | o | | • | |
| REC-2 | • | | • | |
| WARM | • | Dissolved copper[1] | – | |
| WILD | • | | • | |
| Rare, threatened, or endangered species | – | | • | Sediment toxicity |
| Marine habitat | – | Dissolved lead[1] | • | |
| Migration of aquatic organisms | – | | • | |
| Preservation of biological habitats of special significance | – | Dissolved zinc[1] | • | Benthic community effects |
| Estuarine habitat | – | | • | |
| Shellfish harvesting | – | Indicator bacteria | • | |
| Industrial service supply | – | | • | |
| Commercial and sport fishing | – | Diazinon[2] | • | |
| Navigation | – | | • | |

• Existing beneficial use  o Potential beneficial use  – Not applicable

1. These pollutants are on the 2006 State Board §303(d) list of Water Quality Limited Segments for the San Diego Bay.
2. Diazinon was added to the State Board §303(d) list in 1996. The Diazinon TMDL was developed in 2002 to address the contribution of this organophosphate pesticide to storm water toxicity (Regional Board, 2002a).

Federal law requires the San Diego Regional Water Quality Control Board (Regional Board) to develop TMDLs for waters on the State Board §303(d) list. The purpose of a TMDL is to attain applicable water quality objectives (WQOs) and to restore the beneficial uses of impaired waters. Diazinon was frequently detected above water quality benchmarks in most of San Diego County's watersheds, including Chollas Creek between 1994 and 2008. In 2002, the Regional Board adopted the Diazinon TMDL (Resolution No. R9-2002-0123). Diazinon was phased out of manufacturing and is no longer available for retail sale as of December 2004. Water quality results to date indicate that both the TMDL and ban have been effective. Diazinon concentrations have not been detected above the chronic waste load allocation (WLA) since November 30, 2007, and are infrequently detected at the method detection limit.

Dissolved copper, lead, and zinc have been detected above California Toxics Rule (CTR) criteria. In 2004, the Regional Board issued Order No. R9-2004-0277 to provide additional metals data for the Chollas Creek Watershed. The *TMDL for Dissolved Copper, Lead and Zinc in Chollas Creek, Tributary to San Diego Bay* (Chollas Creek Dissolved Metals TMDL) was adopted by the Regional Board in 2007 (Resolution No. R9-2007-0043) and was approved by the Office of Administrative Law on October 22, 2008. The Chollas Creek Dissolved Metals TMDL adopted the compliance monitoring requirements outlined in Order No. R9-2004-0277. The WLAs for dissolved copper, lead, and zinc are based on the default CTR water-effect ratio criteria of 1.0, because no site specific objective has been conducted. The City of San Diego is currently conducting a water-effect ratio study in Chollas Creek to determine the actual concentration at which dissolved copper, lead, and zinc cause toxicity in Chollas Creek waters. The results of this study are anticipated in 2012.

This report represents data and results for Compliance Schedule Year 2.

## 1.2 Dissolved Metals Total Maximum Daily Load Implementation Plan and Annual Report

The Chollas Creek Dissolved Metals TMDL Implementation Plan (Implementation Plan) (Weston, 2009a) was specifically prepared in response to Resolution No. R9-2007-0043 in which the Regional Board incorporated the TMDL for dissolved copper, lead, and zinc into the Basin Plan. The Implementation Plan represents the Discharger's strategy for conducting watershed activities within Chollas Creek Watershed to meet TMDL WLAs. The Implementation Plan uses an iterative, adaptive management strategy for identifying, planning, implementing, and assessing best management practices (BMPs) over the 20-year compliance schedule. The Implementation Plan was submitted to the Regional Board on October 21, 2009. The annual reporting methodology used to develop this document was discussed in the Implementation Plan, and a draft outline of the report structure was submitted to the Regional Board on October 21, 2009. The Implementation Plan is available on the City of San Diego's Think Blue website at www.thinkbluesdregion.org.

## 1.3 Legal Authority

Five of the seven Dischargers are also San Diego Region Municipal Storm Water Copermittees. Order No. R9-2004-0277 (Item 2-a) requires reports of information on how Copermittees implemented their legal authority to remedy the condition of pollution. Copermittees accomplish this primarily through the current Dry Weather Monitoring (DWM) Program and facility inspections conducted under National Pollutant Discharge Elimination System (NPDES) Order No. R9-2007-0001 (Regional Board, 2007a). DWM is conducted throughout Chollas Creek to identify and eliminate illicit connections and illegal discharges (ICIDs). As part of the DWM Program, Diazinon and metals are monitored, and any illicit discharge of Diazinon or metals is eliminated by issuing violations and/or citations. Each Discharger in the Chollas Creek Watershed has ordinances in place to enforce the illegal and unauthorized discharge of waste into their storm drain systems. For more information on enforcement mechanisms, please refer to the Dischargers' individual Jurisdictional Urban Runoff Management Plans (JURMPs).

Caltrans is responsible for the California State Highway System, which possesses its own NPDES Permit (Order No. 99-06-DWQ) (State Board, 1999). The Navy is responsible for Naval Base San Diego and possesses its own industrial only NPDES Permit (Order No. R9-2002-0169) (Regional Board, 2002b).

# 2.0 PUBLIC EDUCATION AND OUTREACH PROGRAMS AND ANNUAL REPORTING

Order No. R9-2004-0277 requires reporting of information on the implementation and efficacy of a Diazinon Toxicity Control Plan and Diazinon Public Outreach/Education Program. Watershed activities that address pesticides under the Implementation Plan fulfilled the requirements of Order No. R9-2004-0277. The 2009 Implementation Plan collaboratively developed by the Dischargers represents an integrated adaptive management strategy for addressing priority water quality problems in the Chollas Creek Watershed (e.g., Diazinon). Progress reports for the watershed activities listed in the Implementation Plan are provided as appendices to the Discharger's annual storm water reports, including the San Diego Bay WURMP Annual Report and the Caltrans Stormwater Management Program Annual Report, as appropriate.

# 3.0 COMPLIANCE MONITORING

Order No. R9-2004-0277 requires water quality monitoring at mass loading stations (MLS) SD8(1) and DPR2. Compliance with the Chollas Creek Dissolved Metals TMDL and the Diazinon TMDL was determined by water quality monitoring at these two locations. Monitoring was conducted during the first and second storms after October 1 and during the first storm after February 1 of each year.

## 3.1 Monitoring Locations

The Chollas Creek Watershed is divided into two main drainage areas separated by the northern and southern forks of Chollas Creek. SD8(1) is the MLS located at the base of the north fork with a drainage area of approximately 8,794 acres. DPR2 is the MLS located at the base of the south fork of Chollas Creek with a drainage area of approximately 7,575 acres. The drainage areas captured from each site are presented in Table 3-1 and on Figure 3-3.

**Table 3-1. Drainage Area Estimates**

| Portion of Chollas Creek | Monitoring Locations | Drainage Area (acres) | Percentage of Watershed |
|---|---|---|---|
| North fork | SD8(1) | 8,794 | 48% |
| South fork | DPR2 | 7,575 | 42% |

Compliance monitoring location SD8(1) was historically located at the end of Durant Street, east of 33rd Street, and approximately 750 ft south of Imperial Avenue. During the 2008–2009 Monitoring Season, sensor readings were impacted due to sediment accumulation where the sampler intake and pressure transducer were located in the channel bottom. A field survey on September 10, 2009 indicated that accumulated sediment and large cobbles would once again impact sensor readings. Therefore, SD8(1) was relocated to a comparable channel cross section of Chollas Creek that would be less impacted by cobbles. SD8(1) was relocated approximately 100 yards upstream of the original site, at the end of Steel Street (lat: 32.70553, long: -117.12121). Field survey notes for the new SD8(1) trapezoidal channel cross section have been provided in Appendix A.

During the 2009-2010 Monitoring Season photos were taken at both the original and current SD8(1) monitoring location to document the differing channel conditions (Figure 3-1 and Figure 3-2). Generally, the accumulated sediment pictured at the new SD8(1) site was deposited after monitoring was complete and washed away during the first flush of water of the monitored event.

**Figure 3-1. Sediment and Cobbles at Original SD8(1) Site (left) versus Relatively Clean Channel Cross Section at New SD8(1) Site (right) – December 2009**

**Figure 3-2. Wide-Angle View of Chollas Creek Showing the New SD8(1) Site in the Foreground, Original SD8(1) Site in the Mid-Photo, and Accumulating Sediment and Cobbles in the Background – February 2010 (left) and May 2010 (right)**

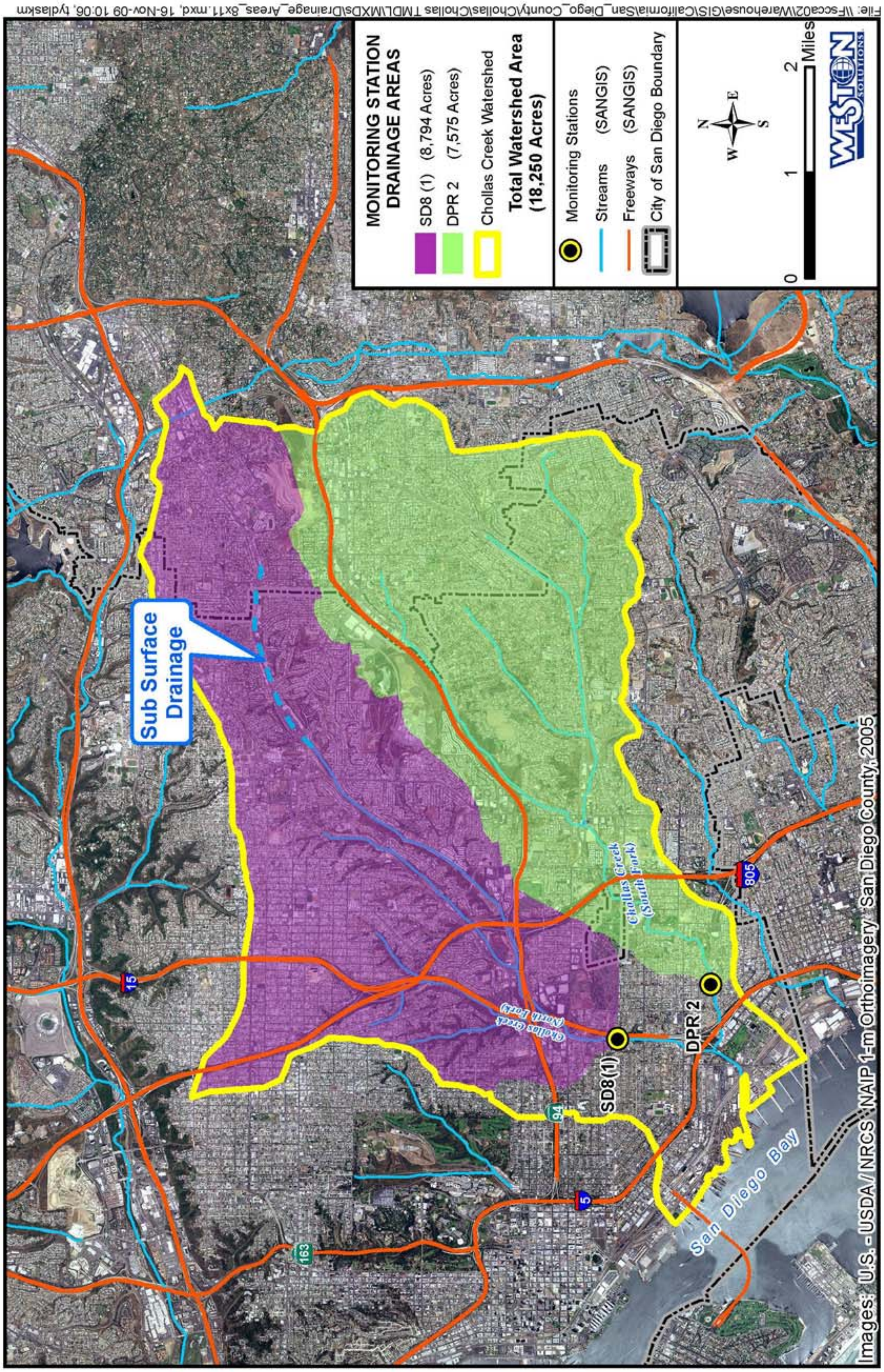



**Figure 3-3. Chollas Creek Mass Loading Stations – SD8(1) and DPR2**

## 3.2 Sampling and Analytical Methods

### 3.2.1 Sampling Methods and Storm Water Quality Monitoring

Storm water runoff was collected using flow-weighted composite techniques over the duration of each storm event. Sample collection was targeted for termination when the storm flow returned to within approximately 10% of the base flow condition, indicated by the end of the precipitation event and the cessation of storm water flow. However, the variable nature of storm water monitoring may have resulted in slight protocol deviations where noted.

Automated flow and sampling equipment were installed at each site to collect flow-weighted composite samples during storm events. American Sigma flowmeters with pressure transducers or bubblers were used to measure velocity and stage height. The flow sensors were installed on the bottom center of the channel.

Using the data collected by the flowmeters, sample intervals were set at flow pacings to collect approximately 40 L of water throughout the storm event. The sample intake point was located adjacent to the flowmeter, on the bottom center of the channel. American Sigma automated samplers were used to collect 1-L sample grabs at a flow-dependent rate. The 1-L grab samples were composited into 20-L borosilicate glass sample bottles. The automated sampler collected grab samples via a peristaltic pumping mechanism. Water samples were pumped through a Teflon intake device and Teflon tubing into a 20-L borosilicate glass sample bottle. Bottles were kept on ice during the storm event. Field crews maintained and replaced the sampling bottles as they filled to capacity. Multiple bottles were composited at Weston Solutions, Inc.'s (Weston's®) facility and subsampled for delivery to the laboratory for chemistry and bioassay toxicity analyses.

A field data log was completed at each site (Appendix B). The field data log includes empirical observations of the site and water quality characteristics. Observations included meteorological conditions at the time of sampling, odor, color, and general runoff turbidity. Changes in the condition of vegetation were noted on the field data logs, as well as any observed erosion along the channel's side slopes.

Flow-weighted composite samples were collected and analyzed for the constituents listed in Table 3-2, in accordance with Order No. R9-2004-0277. Bioassay water samples were collected for use in acute and chronic toxicity tests using *C. dubia*. Grab samples were collected for the field parameters, pH, temperature, and conductivity, which are not conducive to automated composite sampling. Grab samples were collected from the horizontal and vertical center of the channel, where possible.

**Table 3-2. Water Quality Analytical Parameters for Field Parameters and Analytes Required Under Order No. R9-2004-0277**

| Analytical Parameter | Analytical Method | Sample Volume | Container Type | Preservation (e.g., chemical/temperature/ light-protected) | Maximum Holding Time: Preparation/ Analysis |
|---|---|---|---|---|---|
| pH | NA | NA | Analyzed in field | NA | NA |
| Temperature | NA | NA | Analyzed in field | NA | NA |
| Conductivity | NA | NA | Analyzed in field | NA | NA |
| Total hardness | SM 2340-B | 100 mL | Plastic | $HNO_3$ | Six months |
| Total/dissolved copper | USEPA 200.8 | 1 L | Plastic | Store cool at <4ºC * | Six months |
| Total/dissolved lead | USEPA 200.8 | 1 L | Plastic | Store cool at <4ºC * | Six months |
| Total/dissolved zinc | USEPA 200.8 | 1 L | Plastic | Store cool at <4ºC * | Six months |
| Acute toxicity *C. dubia* | USEPA 821-R-02-012 | 10 L | 10-L glass | Store cool at <6ºC | 36 hours |
| Chronic toxicity *C. dubia* | USEPA 821-R-02-013 | 20 L | 20-L glass | Store cool at <6ºC | 36 hours |
| Organophosphorus pesticides (Diazinon) | USEPA 625 | 2 L | Amber glass | Store cool at <4ºC | Extraction – seven days; Analysis – 40 days |
| Chlorinated pesticides | USEPA 625 | 2 L | Amber glass | Store cool at <4ºC | Extraction – seven days; Analysis – 40 days |
| PAHs | USEPA 625 | 2 L | Amber glass | Store cool at <4ºC | Extraction – seven days; Analysis – 40 days |
| PCB congeners | USEPA 625 | 2 L | Amber glass | Store cool at <4ºC | Extraction – seven days; Analysis – 40 days |

NA = not applicable
* Dissolved metals are filtered with a 0.45-µm filter.

### 3.2.2 Quality Assurance / Quality Control Procedures

Field measurements for pH, conductivity, and temperature were taken using an Oakton CON10 pH/temperature/conductivity meter according to the manufacturer specifications. Calibration of the instrument was conducted prior to each sampling event.

Quality assurance and quality control for sampling processes included proper collection of the samples to minimize the possibility of contamination. All samples were collected in certified clean, contaminant-free sample bottles. Field staff wore powder-free nitrile gloves during sample collection. Sampling personnel were trained according to the field sampling standard operating procedures (SOPs). Additionally, the field staff was made aware of the significance of the project's detection limits and the requirement to avoid contamination of samples at all times. The collection of sample duplicates and field blanks were conducted to assess variability and field bias, respectively.

### 3.2.3 Chain-of-Custody Procedures

Chain-of-custody (COC) procedures were used for all samples throughout the collection, transport, and analytical process. Samples were considered to be in custody if they were 1) in the custodian's possession or view, 2) retained in a secured place (i.e., under lock) with restricted access, or 3) placed in a container and secured with an official seal such that the sample could not be reached without breaking the seal. The principal documents used to identify samples and to document possession were COC records, field logbooks, and field tracking forms.

The COC procedures were initiated during sample collection. A COC record was provided with each sample or group of samples. Each person with sample custody signed the form and ensured the samples were not left unattended unless properly secured. Documentation of sample handling and custody included the following:

- Sample identifier.
- Sample collection date and time.
- Any special notations on sample characteristics or analyses.
- Initials of the person collecting the sample.
- Date the sample was sent to the analytical laboratory.
- Shipping company and waybill information, if applicable.

Completed COC forms were placed in a plastic envelope and kept inside the container with the samples. Once delivered to the analytical laboratory, the COC form was signed by the samples recipient. The condition of the samples (i.e., confirming all samples were accounted for and properly labeled, the temperature of the samples, and the integrity of the sample jars) was noted and recorded by the recipient. COC records were included in the final reports prepared by the analytical laboratories and considered an integral part of the report.

### 3.2.4 Trend Assessment Methodology

Using the long-term datasets for SD8(1) and DPR2, a non-parametric trend analysis was conducted using the Mann-Kendall trend test to evaluate the presence or absence of significant trends using available monitoring data. This trend test was employed for analysis of environmental time series data. The test did not assume any single distribution for the data being tested, which was an advantage when analyzing environmental data. The test did not incorporate magnitude, but instead, calculated the number of positive and negative differences between samples. The number of positive and negative differences was summed to calculate the S-statistic, which was compared to a table value to determine significance. Sen’s slope estimator (Sen, 1968) was used to estimate the magnitude of change over time when a significant trend was observed. Sen's slope estimator was a non-parametric method that was insensitive to outliers and was used to infer the magnitude of a trend in the data.

The two long-term datasets contain constituent measurements with levels below the detection limit of the analytical method (non-detect results). The Sen’s slope estimator will exhibit noticeable bias if the number of non-detects exceed 15%. At non-detect levels of 15% or less, both the Mann-Kendall test results and the Sen’s slope estimator were found to be reliable.

### 3.2.5 Water Quality Criteria

Sample results were compared to the water quality criteria shown in Table 3-3. Water chemistry results were compared to criteria from the references listed in the table to determine the magnitude of criteria exceedances from storm water runoff to Chollas Creek.

**Table 3-3.Wet Weather Water Quality Benchmarks for Analyzed Constituents**

| Constituent List | Water Quality Criteria | Criteria Source |
|---|---|---|
| pH | 6.5–9.0 | Basin Plan (Regional Board, 1994) |
| Total/dissolved copper | (a) | Resolution No. R9-2007-0043 |
| Total/dissolved lead | (a) | Resolution No. R9-2007-0043 |
| Total/dissolved zinc | (a) | Resolution No. R9-2007-0043 |
| Diazinon | 72 ng/L (acute exposure);<br>45 ng/L (chronic exposure) | Resolution No. R9-2002-0123(b) |
| Chlorpyrifos | 20 ng/L | CDFG (2000) |
| Malathion | 430 ng/L (acute);<br>100 ng/L (chronic) | CDFG (2000) |
| Acute toxicity<br>*C. dubia* | 100 no-observed-effect concentration (NOEC) (%) | Regional Board Order No. R9-2007-0001 |
| Chronic toxicity<br>*C. dubia* | 100 NOEC (%) | Regional Board Order No. R9-2007-0001 |

(a) Dissolved Metals TMDL WLAs are based on total hardness (as $CaCO_3$) and are calculated as described by Title 40 of the Code of Federal Regulations (Part 131) (USEPA, 2000). Samples collected for the 2008–2009 Monitoring Season are compared to the acute and chronic condition, multiplied by 0.90 (i.e., the margin of safety).

(b) For the Diazinon TMDL (Resolution No. R9-2002-0123), the WLA is set at 72 ng/L for acute exposures and 45 ng/L for chronic exposures. The 45 ng/L chronic exposure is applied to samples collected using a flow-weighted composite method.

The Chollas Creek Dissolved Metals TMDL was adopted on October 22, 2008. The TMDL WLAs for dissolved copper, lead, and zinc were defined by both the acute and the chronic criteria, multiplied by a 10% margin of safety. The WLAs were applied as metals water quality benchmarks since inception of the TMDL.

# 4.0 MONITORING RESULTS

Monitoring results were assessed in relation to the Chollas Creek Dissolved Metals TMDL and Order No. R9-2004-0277. This assessment involved chemical, bacterial, and toxicological test results from three wet weather sampling events at SD8(1) and DPR2. Rainfall and flow data from the 2009–2010 Monitoring Season are provided in Appendix C. The laboratory chemistry and toxicity results are provided in Appendix D.

## 4.1 2009–2010 Rainfall and Flow Data

The Chollas Creek Dissolved Metals TMDL and Order No. R9-2004-0277 require monitoring at SD8(1) and DPR2 for the first and second rainfall events of the storm season after October 1 and the first rainfall event after February 1. Estimation of a representative storm event in San Diego County was based on an evaluation of the long-term data records from the National Weather Service rain gauge located at Lindbergh Field. A typical storm event at Lindbergh Field ranges from 0.19–0.57 inches of rain and lasts six to 12 hours. Since the depth and duration of a typical storm event varies depending on the monitoring station's location within San Diego County, storm events that were preceded by at least 72 hours of dry weather and were forecasted to be greater than 0.10 inches were considered viable events for monitoring.

Three storm events (i.e., November 28, 2009; December 7, 2009; and February 6, 2010) were monitored over the course of the 2009–2010 Monitoring Season. Annual rainfall totals and event-specific rainfall for the 2009–2010 Monitoring Season at SD8(1) and DPR2 are shown in Table 4-1. The watershed received approximately 11.7 inches of rain based on the rain gauge at DPR2. The rain gauge at SD8(1) malfunctioned December 2009 through February 2010. A comparison of rainfall patterns between SD8(1) and DPR2 indicated that a portion of the total annual rainfall data for SD8(1) were not recorded.

The average daily rainfall for the Chollas Creek Watershed is shown on Figure 4-1. Monitored storm events are signified by raindrops on Figure 4-1. The total rainfall measured at San Diego's Lindbergh Field from October 1, 2009 to April 30, 2010, was 10.98 inches.

**Table 4-1. Rainfall Totals for SD8(1) and DPR2 in the Chollas Creek Watershed**

| Storm Event Date | SD8(1) (inches) | DPR2 (inches) |
|---|---|---|
| 11/28/2009–11/29/2009 | 0.48 | 0.26 |
| 12/07/2009 | 1.88 * | 1.88 |
| 02/06/2010 | 0.49 * | 0.44 |

* The rain gauge was inoperable in December 2009 through early February 2010. Data for DPR2 were used during this period.

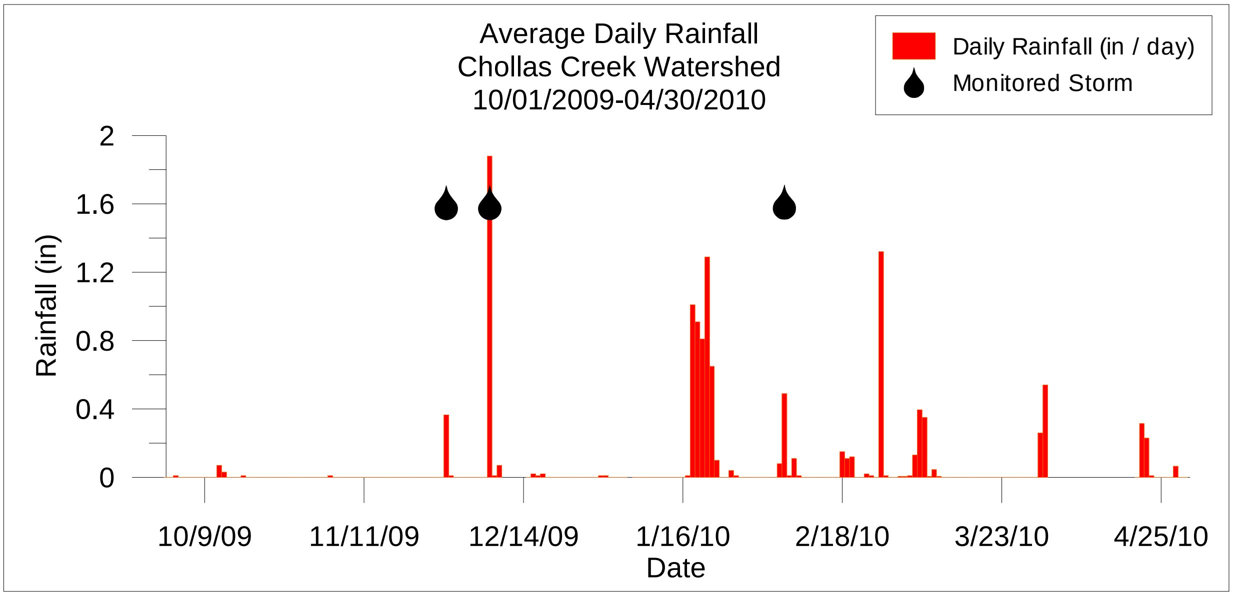



**Figure 4-1. 2009–2010 Average Daily Rainfall Totals for the Chollas Creek Watershed**

Hydrographs depicting flow rates, rainfall, and sample times for the three storm events monitored at SD8(1) and DPR2 during the 2009–2010 Monitoring Season are presented on Figure 4-2 and Figure 4-3, respectively. Annual hydrographs and season flow data for the sites are presented in Appendix C.

The flow sensors installed at SD8(1) and DPR2 at the beginning of the 2009–2010 Monitoring Season measured date, time, and level. The flow rates were calculated based on the channel dimensions and slope.

On Saturday, November 28, 2009, a storm system characterized by flashy storm cells affected the Chollas Creek Watershed with rainfall of 0.48 inches at SD8(1) and 0.26 inches at DPR2. Nearly half of the total rain (0.22 inches) measured at SD8(1) fell between 14:30 and 18:00, while DPR2 only measured 0.04 inches of rainfall during the same time period. The north fork was characterized by two distinct peaks, each peak associated with a major band of rainfall. DPR2 began flowing at approximately 18:00 and rose a second time at 04:00 on November 29, 2009. There was approximately 4.5 times more runoff from the north fork than the south fork (1.9 million $ft^3$ at SD8(1) versus 294,000 $ft^3$ at DPR2).

The storm on Monday, December 7, 2009 was the largest single day storm event monitored during the 2009–2010 Monitoring Season (1.88 inches). Runoff at SD8(1) was characterized by three, consecutively larger flow peaks, each with distinct rise and fall along the hydrograph. A similar flow pattern was observed at DPR2, except where the second and third peaks blended together. There were 35 million $ft^3$ of runoff from SD8(1) and 31 million $ft^3$ of runoff from DPR2.

The first storm after February 1, 2010 (as required by the TMDL, Order No. 2004-0277, and the NPDES Permits), occurred on Saturday, February 6, 2010. The storm produced 0.49 inches of rainfall at SD8(1). The runoff volume measured at SD8(1) was 10.5 million $ft^3$ and 8.4 million $ft^3$ were measured at DPR2.

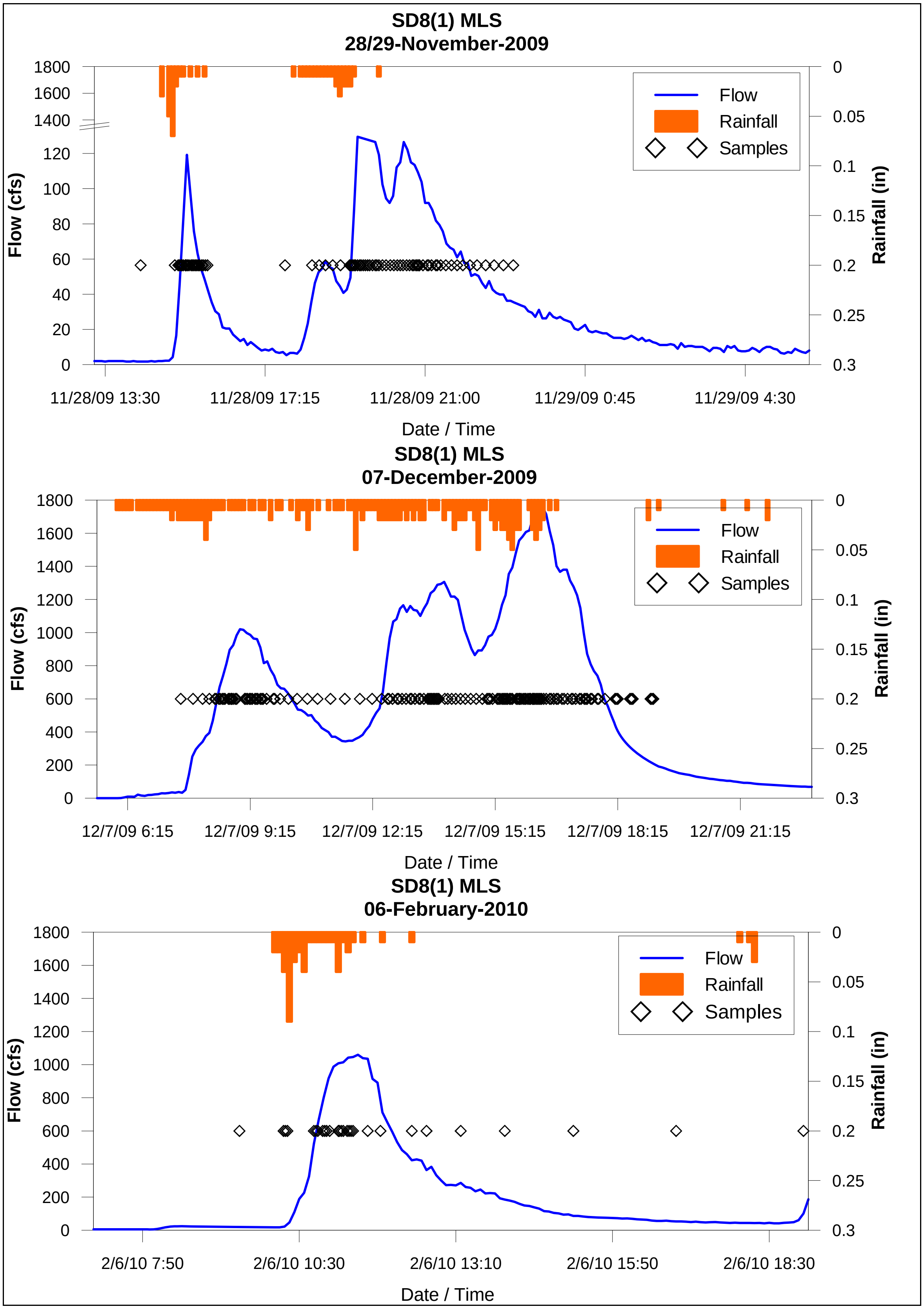



**Figure 4-2. 2009–2010 Storm Hydrographs for SD8(1)**

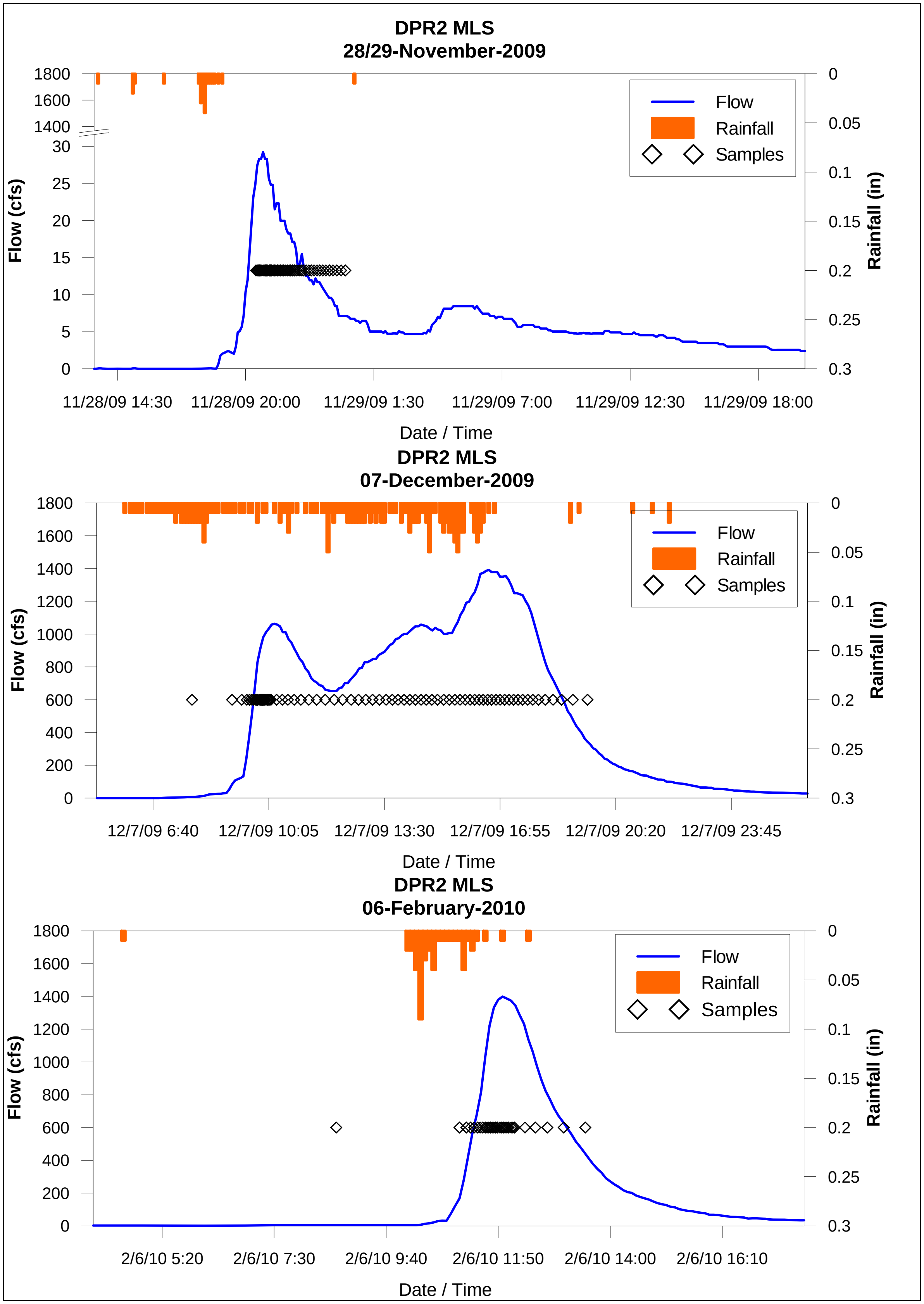



**Figure 4-3. 2009–2010 Storm Hydrographs for DPR2**

## 4.2 Compliance Monitoring Results

This section presents the water quality monitoring results for SD8(1) and DPR2 for the parameters outlined in the Chollas Creek Dissolved Metals TMDL. Samples were analyzed for conventional field parameters, total and dissolved copper, lead, and zinc, total hardness, organophosphate pesticides (i.e., Diazinon), toxicity to *C. dubia*, chlorinated pesticides, PCBs, and PAHs. Wet weather chemistry results for SD8(1) and DPR2 are presented in Table 4-2. Results for toxicity to *C. dubia* are presented in Table 4-3. Results greater than the water quality benchmark were bolded and shaded.

**Metals**

For the purpose of assessing compliance with the Chollas Creek Dissolved Metals TMDL the dissolved metals are compared to the WLAs. Dissolved copper concentrations were above the acute WLAs for both the north and south fork sites of Chollas Creek during the first and second monitoring events. The dissolved copper results were also above the chronic WLA for the February monitoring event at both sites. Dissolved zinc was greater than the acute WLA at SD8(1) during the first and second monitoring events, but below the acute and chronic WLAs during the February monitoring event. Dissolved zinc was below the acute and chronic WLA during all three monitoring events at DPR2. All results were below the acute WLAs for dissolved lead. However, results were above the chronic WLA for dissolved lead at both SD8(1) and DPR2 during the first and second monitoring events, but below the chronic WLA during the February monitoring event at both sites.

**Organophosphate Pesticides**

Of the organophosphate pesticides, only two analytes were detected (i.e., Diazinon and Malathion). Diazinon concentrations were below the acute and chronic WLAs during all storm events at both sites. Diazinon was only detected at site SD8(1) during the second monitoring event (December 7, 2009). Malathion was detected during the December 7, 2009 and February 6, 2010 monitoring events. During the December storm event, Malathion concentrations in the DPR2 sample and SD8(1) field duplicate were greater than the chronic water quality benchmark. The SD8(1) field sample result was below the reporting limit, suggesting high variability in the sample results, possibly due to particulate bound concentrations. Toxicity to *C. dubia* was not observed in relation to any of the organophosphate pesticides detected on December 7, 2009, or February 6, 2010.

**Toxicity**

No acute or chronic survival toxicity was observed during the three monitoring events. However, reproductive toxicity was observed during the first storm event on November 27, 2009, approximately 279 days after the last significant rainfall event of the 2008-2009 Monitoring Season (i.e., February 18, 2009). It should be noted that pollutants may buildup during extended dry periods. Pollutant buildup over the 279 antecedent dry weather days may have added to the potential for toxic effects observed for the *C. dubia* reproductive test during the first flush storm of the Monitoring Season.

**Polynuclear Aromatic Hydrocarbons, Chlorinated Pesticides, and Polychlorinated Biphenyls**

PAHs were detected during each event at both SD8(1) and DPR2 (refer to Table 4-2 for individual analyte concentrations). Total PAHs were roughly 2 times higher at SD8(1) than DPR2 during the first and second storm events of the season, but were slightly higher at DPR2 during the February storm event. Total PAHs ranged from 1,286 ng/L to 2,658 ng/L at SD8(1) and from 304 ng/L to 1,850 ng/L at DPR2.

The results for total chlorinated pesticides, which ranged from 25 ng/L to 93 ng/L, were similar at SD8(1) and DPR2. Trace levels of alpha and gamma chlordane and cis- and trans- nonachlor were commonly detected at both SD8(1) and DPR2. One detection of 4,4-DDE was noted at DPR2 and one detection of Endosulfan-I was noted at SD8(1) during the February monitoring event (20 ng/L).

PCB congeners were not detected during any of the three monitoring events at SD8(1). Fourteen PCB congeners were detected at DPR2, at low concentrations, only during the February storm event. All PCB concentrations ranged from less than the reporting limit to 28 ng/L (refer to Table 4-2 for individual analyte concentrations). The total PCB concentration measured at DPR2 during the February storm event was 203 ng/L.

**Table 4-2. 2009–2010 Chollas Creek Wet Weather Compliance Monitoring Chemistry Results**

| Parameter | Units | Water Quality Benchmark | Benchmark Reference | SD8(1) | SD8(1)-DUP | SD8(1) | SD8(1)-DUP | CC-SD8(1) | DPR2 | DPR2 | DPR2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 11/28/2009-11/29/2009 | 11/28/2009-11/29/2009 | 12/7/2009 | 12/7/2009 | 2/6/2010 | 11/28/2009-11/29/2009 | 12/7/2009 | 2/6/2010 |
| **Physical Chemistry** | | | | | | | | | | | |
| Precipitation | inches | | | 0.48 | 0.48 | 1.88+ | 1.88+ | 0.49 | 0.26 | 1.88 | 0.44 |
| pH | pH units | 6.5-9.0 | Basin Plan | 7.65 | 7.66 | 7.56 | 7.52 | 6.98 | 7.01 | 7.33 | 7.18 |
| Conductivity | µS/cm | | | 280 | 289 | 14.8 | 14.7 | 120.6 | 7.45 | 14.8 | 215 |
| Temp | Celsius | | | 15.9 | 15.8 | 179.6 | 182.4 | 15.3 | 14.4 | 448 | 15.7 |
| **Chlorinated Pesticides** | | | | | | | | | | | |
| 2,4'-DDD | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| 2,4'-DDE | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| 2,4'-DDT | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| 4,4'-DDD | ng/L | | | <5 | <5 | | <5 | <5 | <5 | <5 | <5 |
| 4,4'-DDE | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 20.3 |
| 4,4'-DDT | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Aldrin | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| BHC-alpha | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| BHC-beta | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| BHC-delta | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| BHC-gamma | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Chlordane-alpha | ng/L | | | 16.1 | 10 | 12 | 15.6 | 19.3 | <5 | 8.1 | 23.3 |
| Chlordane-gamma | ng/L | | | 19.5 | 19.7 | 13 | 13.1 | 20 | <5 | 6.8 | 27 |
| DCPA (Dacthal) | ng/L | | | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Dicofol | ng/L | | | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 |
| Dieldrin | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Endosulfan Sulfate | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Endosulfan-I | ng/L | | | <5 | <5 | <5 | <5 | 21.9 | <5 | <5 | <5 |
| Endosulfan-II | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Endrin | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Endrin Aldehyde | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Endrin Ketone | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Heptachlor | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Heptachlor Epoxide | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Methoxychlor | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Mirex | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Oxychlordane | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Perthane | ng/L | | | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Toxaphene | ng/L | | | - | - | <50 | <50 | - | <50 | <50 | <50 |
| cis-Nonachlor | ng/L | | | <5 | <5 | 4.7 J | 5.5 | 5.3 | <5 | 3.5 J | 5.9 |

**Table 4-2. 2009–2010 Chollas Creek Wet Weather Compliance Monitoring Chemistry Results**

| Parameter | Units | Water Quality Benchmark | Benchmark Reference | SD8(1) | SD8(1)-DUP | SD8(1) | SD8(1)-DUP | CC-SD8(1) | DPR2 | DPR2 | DPR2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 11/28/2009-11/29/2009 | 11/28/2009-11/29/2009 | 12/7/2009 | 12/7/2009 | 2/6/2010 | 11/28/2009-11/29/2009 | 12/7/2009 | 2/6/2010 |
| trans-Nonachlor | ng/L | | | 6.3 | 19.8 | 12.7 | 10 | 15 | <5 | 6.7 | 16.5 |
| Total Chlorinated Pesticides | ng/L | | | 41.9 | 49.5 | 42.4 | 44.2 | 81.5 | <50 | 25.1 | 93 |
| **Organophosphorus Pesticides** | | | | | | | | | | | |
| Azinphos Methyl | ng/L | | | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 |
| Bolstar (Sulprofos) | ng/L | | | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 |
| Chlorpyrifos | ng/L | 20/14 | CA Dept. of Fish & Game, 2000 (Acute/Chronic) | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| Demeton | ng/L | | | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| Diazinon | ng/L | 72/45 | Chollas Creek TMDL for Diazinon | <4 | <4 | 10.3 | 5.7 | <4 | <4 | <4 | <4 |
| Dichlorvos | ng/L | | | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 |
| Dimethoate | ng/L | | | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 |
| Disulfoton | ng/L | | | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| Ethoprop (Ethoprofos) | ng/L | | | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| Ethyl Parathion | ng/L | | | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| Fenchlorphos (Ronnel) | ng/L | | | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 |
| Fenitrothion | ng/L | | | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 |
| Fensulfothion | ng/L | | | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| Fenthion | ng/L | | | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 |
| Malathion | ng/L | 430/100 | CA Dept. of Fish & Game, 1998 (Acute/Chronic) | <6 | <6 | <6 | **120.3** | 95.8 | <6 | **213.4** | 56.1 |
| Merphos | ng/L | | | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| Methamidophos (Monitor) | ng/L | | | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 |
| Methidathion | ng/L | | | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 |
| Methyl Parathion | ng/L | | | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| Mevinphos (Phosdrin) | ng/L | | | <16 | <16 | <16 | <16 | <16 | <16 | <16 | <16 |
| Phorate | ng/L | | | <12 | <12 | <12 | <12 | <12 | <12 | <12 | <12 |
| Phosmet | ng/L | | | <100 | <100 | <100 | <100 | <100 | <100 | <100 | <100 |
| Tetrachlorvinphos (Stirofos) | ng/L | | | <4 | <4 | <4 | <4 | <4 | <4 | <4 | <4 |
| Tokuthion | ng/L | | | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 |
| Trichloronate | ng/L | | | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| **PCB Congeners** | | | | | | | | | | | |
| PCB003 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB008 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB018 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 4.9 J |

**Table 4-2. 2009–2010 Chollas Creek Wet Weather Compliance Monitoring Chemistry Results**

| Parameter | Units | Water Quality Benchmark | Benchmark Reference | SD8(1) | SD8(1)-DUP | SD8(1) | SD8(1)-DUP | CC-SD8(1) | DPR2 | DPR2 | DPR2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 11/28/2009-11/29/2009 | 11/28/2009-11/29/2009 | 12/7/2009 | 12/7/2009 | 2/6/2010 | 11/28/2009-11/29/2009 | 12/7/2009 | 2/6/2010 |
| PCB028 | ng/L | | | - | - | <5 | <5 | <5 | - | <5 | 12.2 |
| PCB028+31 | ng/L | | | <5 | <5 | - | - | - | <5 | - | - |
| PCB031 | ng/L | | | - | - | <5 | <5 | <5 | - | <5 | 7.5 |
| PCB033 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 4.2 J |
| PCB037 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB044 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 27.5 |
| PCB049 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 15.7 |
| PCB052 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 27.8 |
| PCB056/060 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 12 |
| PCB066 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 21.1 |
| PCB070 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 23.4 |
| PCB074 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB077 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB081 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB087 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB095 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 8.8 |
| PCB097 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB099 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 11.1 |
| PCB101 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 13.8 |
| PCB105 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB110 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 13.3 |
| PCB114 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB118 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB119 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB123 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB126 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB128 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB132 | ng/L | | | <5 | <5 | - | - | - | <5 | - | - |
| PCB138 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB141 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB149 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB151 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB153 | ng/L | | | - | - | <5 | <5 | <5 | - | <5 | <5 |
| PCB153+168 | ng/L | | | <5 | <5 | - | - | - | - | - | - |
| PCB156 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB157 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |

**Table 4-2. 2009–2010 Chollas Creek Wet Weather Compliance Monitoring Chemistry Results**

| Parameter | Units | Water Quality Benchmark | Benchmark Reference | SD8(1) | SD8(1)-DUP | SD8(1) | SD8(1)-DUP | CC-SD8(1) | DPR2 | DPR2 | DPR2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 11/28/2009-11/29/2009 | 11/28/2009-11/29/2009 | 12/7/2009 | 12/7/2009 | 2/6/2010 | 11/28/2009-11/29/2009 | 12/7/2009 | 2/6/2010 |
| PCB158 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB167 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB168+132 | ng/L | | | - | - | <5 | <5 | <5 | - | <5 | <5 |
| PCB169 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB170 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB174 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB177 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB180 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB183 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB187 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB189 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB194 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB195 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB200 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB201 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB203 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB206 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| PCB209 | ng/L | | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Total PCB Congeners | ng/L | | | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 203.3 |
| **Polynuclear Aromatic Hydrocarbons** | | | | | | | | | | | |
| 1-Methylnaphthalene | ng/L | | | 38.9 | 36.4 | 8.2 | 8.3 | 5.7 | 17.4 | 8.2 | 6.3 |
| 1-Methylphenanthrene | ng/L | | | 41.9 | 56.3 | 19.7 | 17.2 | 13.2 | 3.8 J | 14.2 | 21.4 |
| 2,3,5-Trimethylnaphthalene | ng/L | | | 10.6 | 16.1 | 18.6 | <5 | <5 | 9 | 4.7 J | <5 |
| 2,6-Dimethylnaphthalene | ng/L | | | 20.3 | 18.3 | 7 | 6.2 | 4 J | 5.2 | 4.5 J | 4 J |
| 2-Methylnaphthalene | ng/L | | | 38.9 | 31.9 | 10 | 10.5 | 12.2 | 16.3 | 10.7 | 13.1 |
| Acenaphthene | ng/L | | | 18.5 | 13.1 | 2.3 J | 3.5 J | 5.5 | 2.9 J | 1.4 J | 3 J |
| Acenaphthylene | ng/L | | | 33.7 | 29.6 | 5.6 | 5.8 | 4.3 J | 35.9 | 7.1 | 15.2 |
| Anthracene | ng/L | | | 28.2 | 26.2 | 11.4 | 13.7 | 19.2 | 6 | 12.6 | 25.7 |
| Benz[a]anthracene | ng/L | | | 113.3 | 116.4 | 67.8 | 74.9 | 71.6 | 8 | 50 | 84.6 |
| Benzo[a]pyrene | ng/L | | | 57.3 | 71.6 | 59.1 | 58.4 | 57 | 4.6 J | 50.6 | 144 |
| Benzo[b]fluoranthene | ng/L | | | 238.4 | 222.6 | 90.8 | 95.9 | 97.4 | 11.8 | 66.6 | 123.5 |
| Benzo[e]pyrene | ng/L | | | 130.4 | 132 | 66 | 72.3 | 89.7 | 12.1 | 53.7 | 114.3 |
| Benzo[g,h,i]perylene | ng/L | | | 135.5 | 128.5 | 98.2 | 95.8 | 72.2 | <5 | 76.3 | 92.3 |
| Benzo[k]fluoranthene | ng/L | | | 38.4 | 52.1 | 25 | 36.5 | 44.4 | 3.4 J | 20 | 81.9 |
| Biphenyl | ng/L | | | 21.2 | 33.5 | 6.8 | 7.8 | 10.9 | 9.2 | 7.9 | 5.4 |
| Chrysene | ng/L | | | 144.8 | 170.3 | 191.9 | 196.5 | 173.8 | 10.4 | 134.5 | 193.2 |

**Table 4-2. 2009–2010 Chollas Creek Wet Weather Compliance Monitoring Chemistry Results**

| Parameter | Units | Water Quality Benchmark | Benchmark Reference | SD8(1) | SD8(1)-DUP | SD8(1) | SD8(1)-DUP | CC-SD8(1) | DPR2 | DPR2 | DPR2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 11/28/2009-11/29/2009 | 11/28/2009-11/29/2009 | 12/7/2009 | 12/7/2009 | 2/6/2010 | 11/28/2009-11/29/2009 | 12/7/2009 | 2/6/2010 |
| Dibenz[a,h]anthracene | ng/L | | | <5 | 240 | <5 | <5 | 14.8 | <5 | <5 | 13.1 |
| Dibenzothiophene | ng/L | | | 95.3 | 95.2 | 39.2 | 40.8 | 38.1 | 42.4 | 41.9 | 27 |
| Fluoranthene | ng/L | | | 259.6 | 310.6 | 189.5 | 194.7 | 219.6 | 21.5 | 123.2 | 276.7 |
| Fluorene | ng/L | | | 31.7 | 20.6 | 5 | 7.4 | 5.4 | 5.2 | 5.9 | 6.7 |
| Indeno[1,2,3-c,d]pyrene | ng/L | | | 61.5 | 86.8 | 56.2 | 51.1 | 63.1 | <5 | 41.7 | 72.7 |
| Naphthalene | ng/L | | | 40.5 | 50.4 | 23.4 | 21.3 | 15.3 | 31.4 | 40.3 | 19.6 |
| Perylene | ng/L | | | 187.9 | 186.3 | 33.2 | 33.6 | 50.1 | 12.3 | 22.7 | 80.4 |
| Phenanthrene | ng/L | | | 150.8 | 176.4 | 72.2 | 84.7 | 82.9 | 15.7 | 53.1 | 113.8 |
| Pyrene | ng/L | | | 295.2 | 336.5 | 178.8 | 173.9 | 212 | 19.1 | 136.3 | 312.2 |
| Total Polynuclear Aromatic Hydrocarbons | ng/L | | | 2232.8 | 2657.7 | 1285.9 | 1310.8 | 1382.4 | 303.6 | 988.1 | 1850.1 |
| **General Chemistry** | | | | | | | | | | | |
| Total Hardness as CaCO3 | mg/L | | | 127.6 | 127.5 | 39.8 | 41 | 79.2 | 130.1 | 65.8 | 48.9 |
| **Total Metals** | | | | | | | | | | | |
| Copper (Cu) | µg/L | | | 70.7 | 72.7 | 27.9 | 28.4 | 24.6 | 34.9 | 25.3 | 30.8 |
| Lead (Pb) | µg/L | | | 42.01 | 46.47 | 22.56 | 22.69 | 22.47 | 6.07 | 19.79 | 34.08 |
| Zinc (Zn) | µg/L | | | 470.1 | 533.6 | 200.9 | 205.4 | 134.1 | 122.9 | 162.8 | 216.8 |
| **Dissolved Metals** | | | | | | | | | | | |
| Copper (Cu) | µg/L | (a) | 40 CFR 131.38 | **24.8** | **24.5** | **8.1** | **7.7** | **8.6** | **28.8** | **8.8** | **4.8** |
| Lead (Pb) | µg/L | (a) | 40 CFR 131.38 | **5.3** | **5.16** | **2.77** | **2.86** | 0.74 | **3.61** | **2.72** | 0.48 |
| Zinc (Zn) | µg/L | (a) | 40 CFR 131.38 | **150.5** | **149.3** | **58.8** | **62.6** | 29.6 | 100.9 | 56 | 17.4 |
| **Dissolved Metals Waste Load Allocations (WLAs)** | | | | | | | | | | | |
| Copper (Cu) - acute | µg/L | (a) | 40 CFR 131.38 | 15.2 | 15.2 | 5.1 | 5.2 | 9.7 | 15.5 | 8.1 | 6.2 |
| Copper (Cu) - chronic | µg/L | (a) | 40 CFR 131.38 | 9.9 | 9.9 | 3.7 | 3.8 | 6.6 | 10.1 | 5.6 | 4.4 |
| Lead (Pb) - acute | µg/L | (a) | 40 CFR 131.38 | 75.71 | 75.65 | 21.04 | 21.75 | 45.05 | 77.32 | 36.75 | 26.46 |
| Lead (Pb) -chronic | µg/L | (a) | 40 CFR 131.38 | 2.95 | 2.95 | 0.82 | 0.85 | 1.76 | 3.01 | 1.43 | 1.03 |
| Zinc (Zn) -acute | µg/L | (a) | 40 CFR 131.38 | 129.7 | 129.6 | 48.3 | 49.5 | 86.6 | 131.8 | 74.0 | 57.5 |
| Zinc (Zn) - chronic | µg/L | (a) | 40 CFR 131.38 | 130.7 | 130.6 | 48.7 | 50.0 | 87.3 | 132.9 | 74.6 | 58.0 |

J-Analyte was detected at concentration below the reporting limit and above the method detection limit. Reported value is estimated.

< result less than the reporting limit.

- No data provided.

(a) Water quality objective(s) for dissolved metal fractions are based on Total Hardness (as CaCO3) and are calculated as described by Title 40 of the Code of Federal Regulations (Part 131) (USEPA, 2000).
Chollas Creek Dissolved Metals TMDL waste load allocations (90% of the CMC and CCC) were used as the WQO for storms after October 4, 2008.

* Indicates reporting limit above the water quality objective.

+ Rain gauge malfunction. Used DPR2 rain data.

Bold only exceed the Chronic or CCC water quality benchmark.

Bold and shaded exceed the CMC and CCC water quality benchmarks.

**Table 4-3. 2009–2010 Chollas Creek Wet Weather Biological Toxicity Results for Ceriodaphnia dubia**

| Test | Reporting Value | Unit | SD8(1) 11/28/2009-11/29/2009 | SD8(1)-DUP[1] 11/28/2009-11/29/2009 | SD8(1) 12/7/2009 | SD8(1)-DUP 12/7/2009 | SD8(1)[2] 2/6/2010 | DPR2 11/28/2009-11/29/2009 | DPR2 12/7/2009 | DPR2 2/6/2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| 96-hour acute toxicity (*C. dubia*) | Mean % survival for control | % | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | % survival in 100% concentration | % | 100 | 90 | 100 | 100 | 100 | 88.9 | 100 | 100 |
| | $LC_{50}$ | % | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | LOEC | % | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | $Tu_a$ | | 0 | 0.59 | 0 | 0 | 0 | 0.61 | 0 | 0 |
| | $LT_{50}$ | Hours | >96 | >96 | >96 | >96 | >96 | >96 | >96 | >96 |
| **Toxicity Observed** | | | No | No | No | No | No | No | No | No |
| 7-day chronic toxicity (*C. dubia*) | Mean % survival for control | % | 100 | 100 | 100 | 90 | 100 | 100 | 100 | 100 |
| | % survival in 100% concentration | % | 100 | 90 | 100 | 100 | 90 | 88.9 | 100 | 100 |
| | $LC_{50}$ (survival) | % | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | NOEC (survival) | % | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | LOEC (survival) | % | >100 | >100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | $Tu_a$ (survival) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | $LT_{50}$ | Hours | >168 | >168 | >168 | >168 | >192 | >192 | >168 | >168 |
| | NOEC (reproduction) | % | **50** | **50** | 100 | 100 | 100 | 100 | 100 | 100 |
| | LOEC (reporduction) | % | 100 | 100 | >100 | >100 | >100 | >100 | >100 | >100 |
| | $Tu_c$ (reproduction) | % | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Toxicity Observed** | | | Yes | Yes | No | No | No | No | No | No |

(1) Control appears to have been contaminated. CC-SD8(1) control was concurrent and was used for this test.

(2) Percent mean standard deivation (MSDp) for reproduction is out of range. Control reproduction did not meet acceptability criteria.

# 5.0 DATA ANALYSIS AND INTERPRETATION

Historical wet weather data have been collected at site SD8(1) since 1994 and at site DPR2 since 2004. The following sections provide analysis and interpretation of the compliance monitoring and additional analytical results from SD8(1) and DPR2 during the 2009–2010 Monitoring Season as compared to historical data.

**2009–2010 Storm Event Analysis**

The data for dissolved copper, lead, and zinc, Diazinon, and toxicity to *C. dubia* for sites SD8(1) and DPR2 are presented graphically by monitored storm event on Figure 5-1, Figure 5-2, and Figure 5-3. These figures present a comparison of which analytes were above the WLA and how the results compare for toxicity at each site.

Storm specific exceedance ratios for dissolved copper, lead, and zinc, along with a ratio representing the mean historical results for each analyte, were calculated for the acute and chronic condition as presented on Figure 5-4 and Figure 5-5, respectively.

Dissolved copper was above the acute WLA at sites SD8(1) and DPR2 during the first and second storm events monitored. Dissolved lead was only above the chronic WLA at both sites during the first and second storm events. Dissolved zinc was above the acute WLA at site SD8(1) and was below the chronic WLA at DPR2 during the first and second storm events monitored. All dissolved copper, lead, and zinc concentrations were less than the acute WLAs during the third storm event (i.e., February 6, 2010). Dissolved copper at sites SD8(1) and DPR2 was the only constituent measured above the chronic WLA during the third storm.

As indicated by Figure 5-4 and Figure 5-5, the WLA exceedance ratios for dissolved copper, lead, and zinc differed between the north fork and south fork of Chollas Creek. At SD8(1), copper concentrations were approximately 1.6 times greater than the acute WLA. At DPR2, copper was nearly twice the WLA with a ratio of 1.9 during the first-flush storm event; however, it dropped to 1.08 times the WLA during the second monitored storm in December 2009. The chronic copper exceedance ratios were generally less than three. Dissolved zinc concentrations at SD8(1) were generally less than 1.3 times the acute WLA and less than 1.0 for the chronic WLA. Dissolved lead concentrations were below the acute and chronic WLA for both sites during the third storm event (February 6, 2010).

The 2009–2010 compliance monitoring data reflected generally understood patterns for the Chollas Creek Watershed, including the following:

- Exceedance ratios for dissolved copper, lead, and zinc were generally greater in the north fork (SD8(1)) than in the south fork (DPR2).
- Metals concentrations had higher rates of exceedance during the first-flush storm event of the season.
- Copper had a higher detection rate and exceedance rate than other metals.
- Lead concentrations never exceeded the acute water quality benchmark; however, the chronic WLA was commonly exceeded at low levels at both sites.

- The mean exceedance ratios were less than two for the acute condition and less than three for the chronic condition.

During Compliance Schedule Year 2 (2009–2010 Monitoring Season), there was no acute or chronic survival toxicity observed at either site during the three monitored event. Only one instance of seven-day chronic reproductive toxicity to *C. dubia* was observed at SD8(1) during the first-flush storm event on November 28, 2009.

The historical dissolved copper, lead, and zinc exceedance ratios are presented on Figure 5-6 through Figure 5-8. These figures compare the dissolved metals results normalized by the hardness values to the acute and chronic WLAs, and the five-unit moving average. It is evident that dissolved copper concentrations at SD8(1) spiked in November 2007 and both concentration and rate of exceedance have steadily decreased over time.

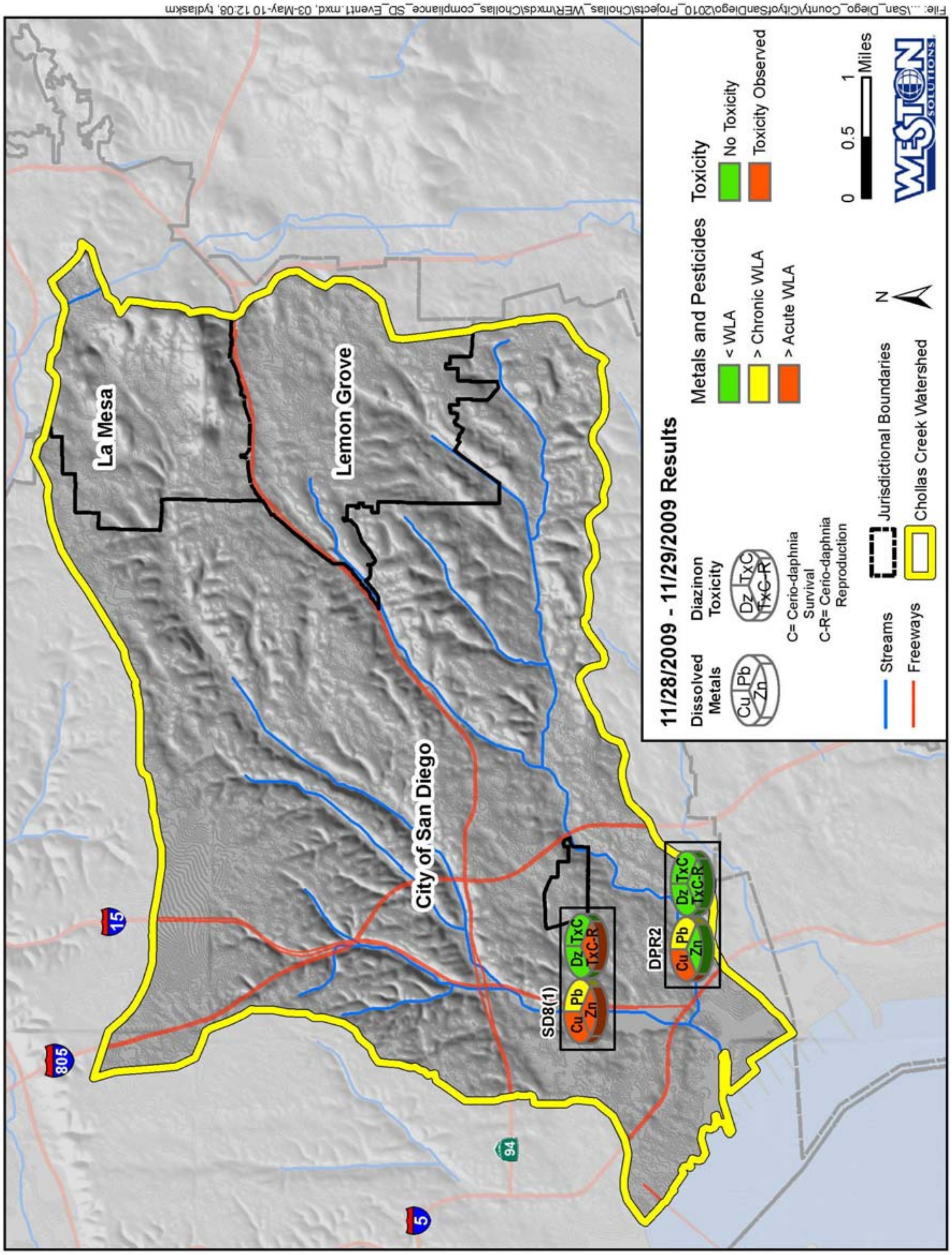



**Figure 5-1. Metals, Pesticides, and Toxicity Results for SD8(1) and DPR2 for November 28, 2009**

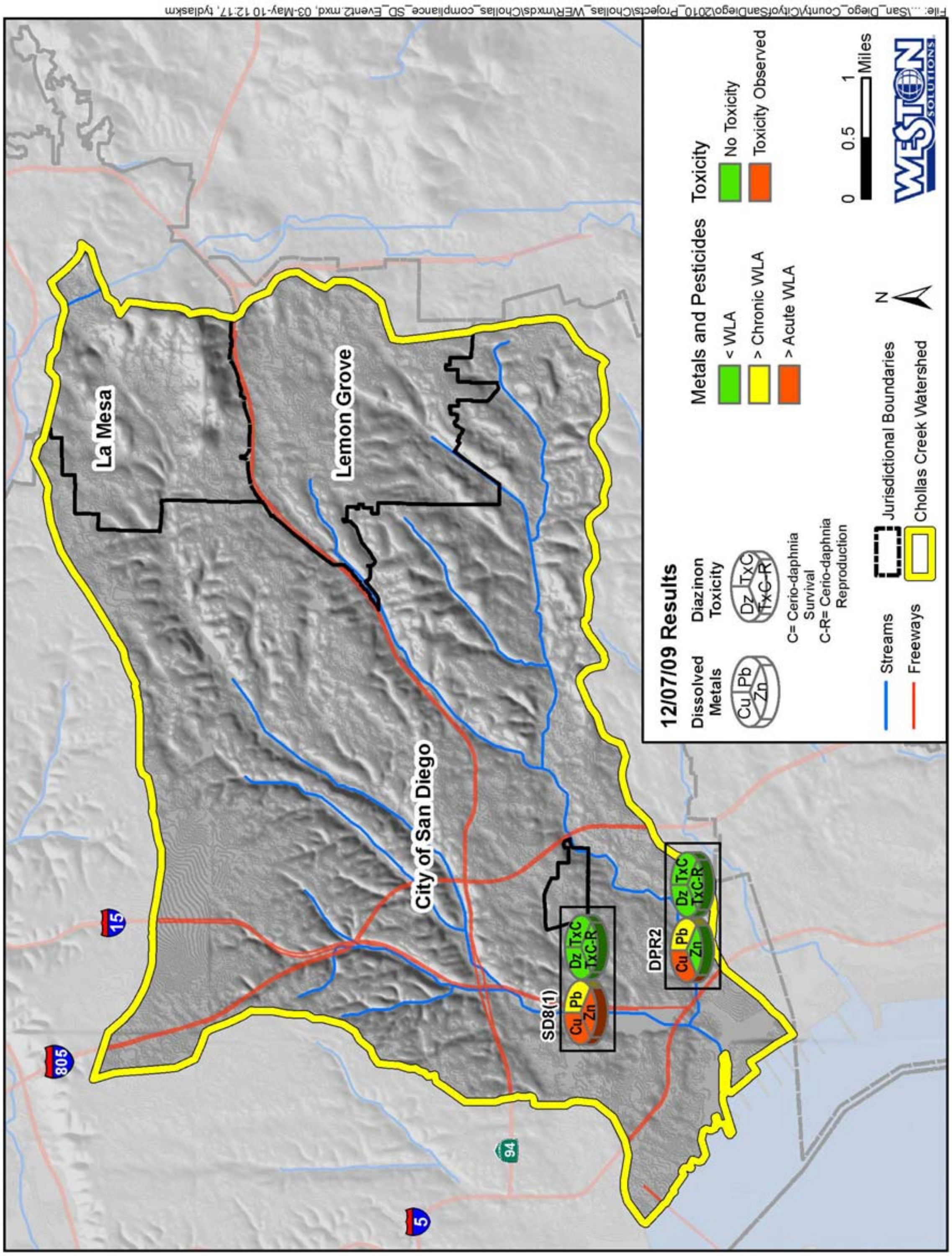



**Figure 5-2. Metals, Pesticides, and Toxicity Results for SD8(1) and DPR2 for December 7, 2009**

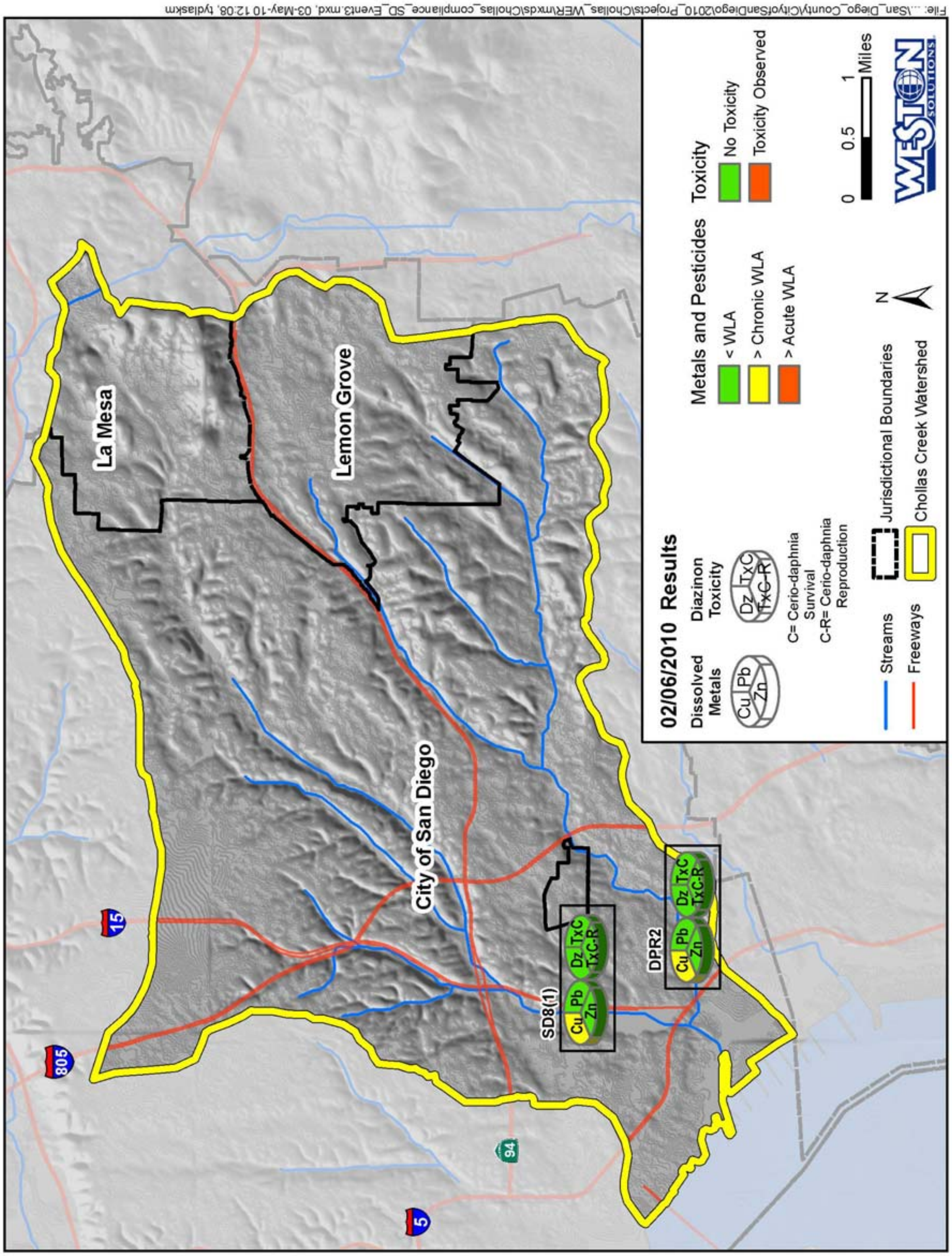



**Figure 5-3. Metals, Pesticides, and Toxicity Results for SD8(1) and DPR2 for February 6, 2010**

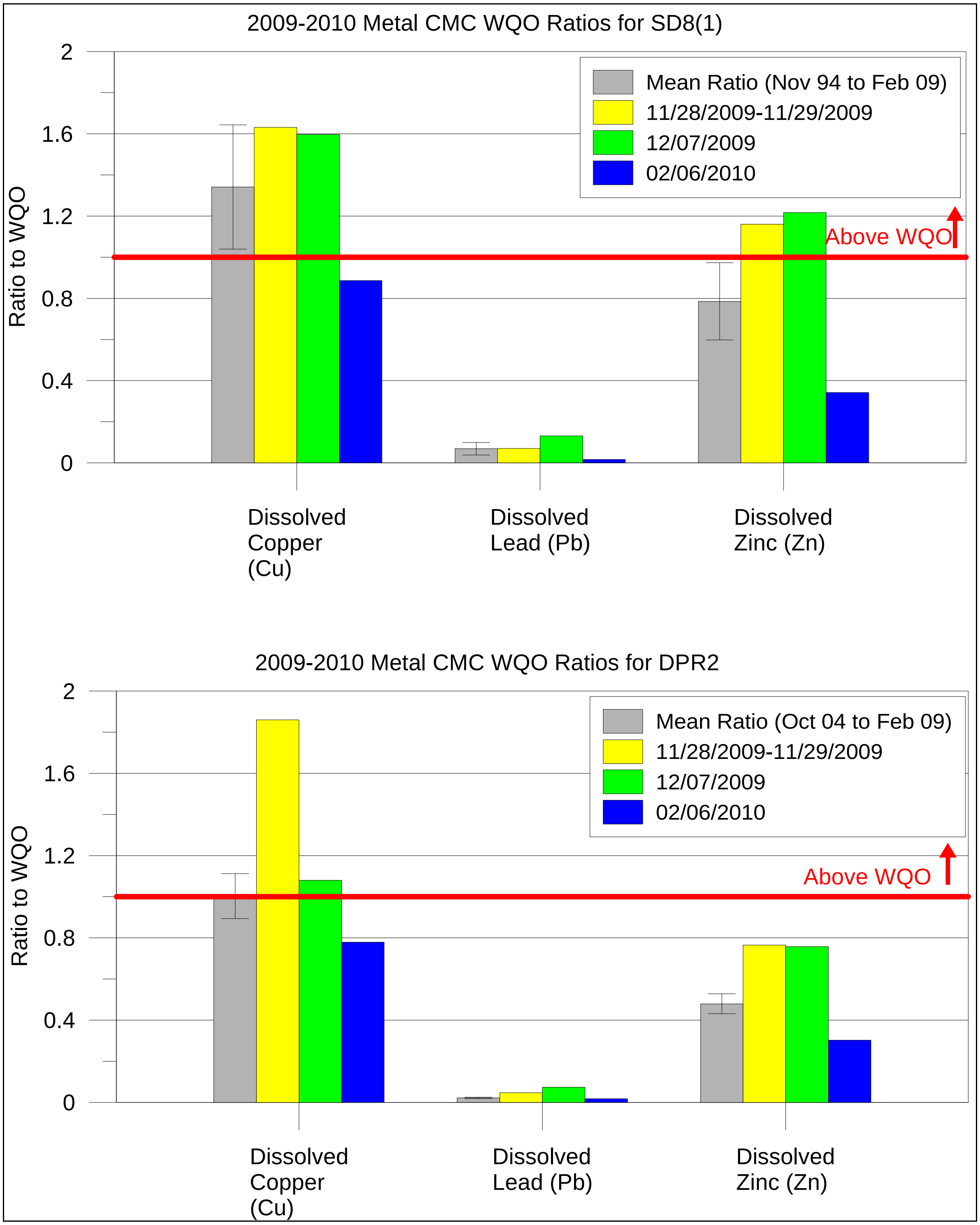



**Figure 5-4. 2009–2010 Ratio Plots for Metals Concentrations Compared to the Acute Waste Load Allocation at SD8(1) and DPR2**

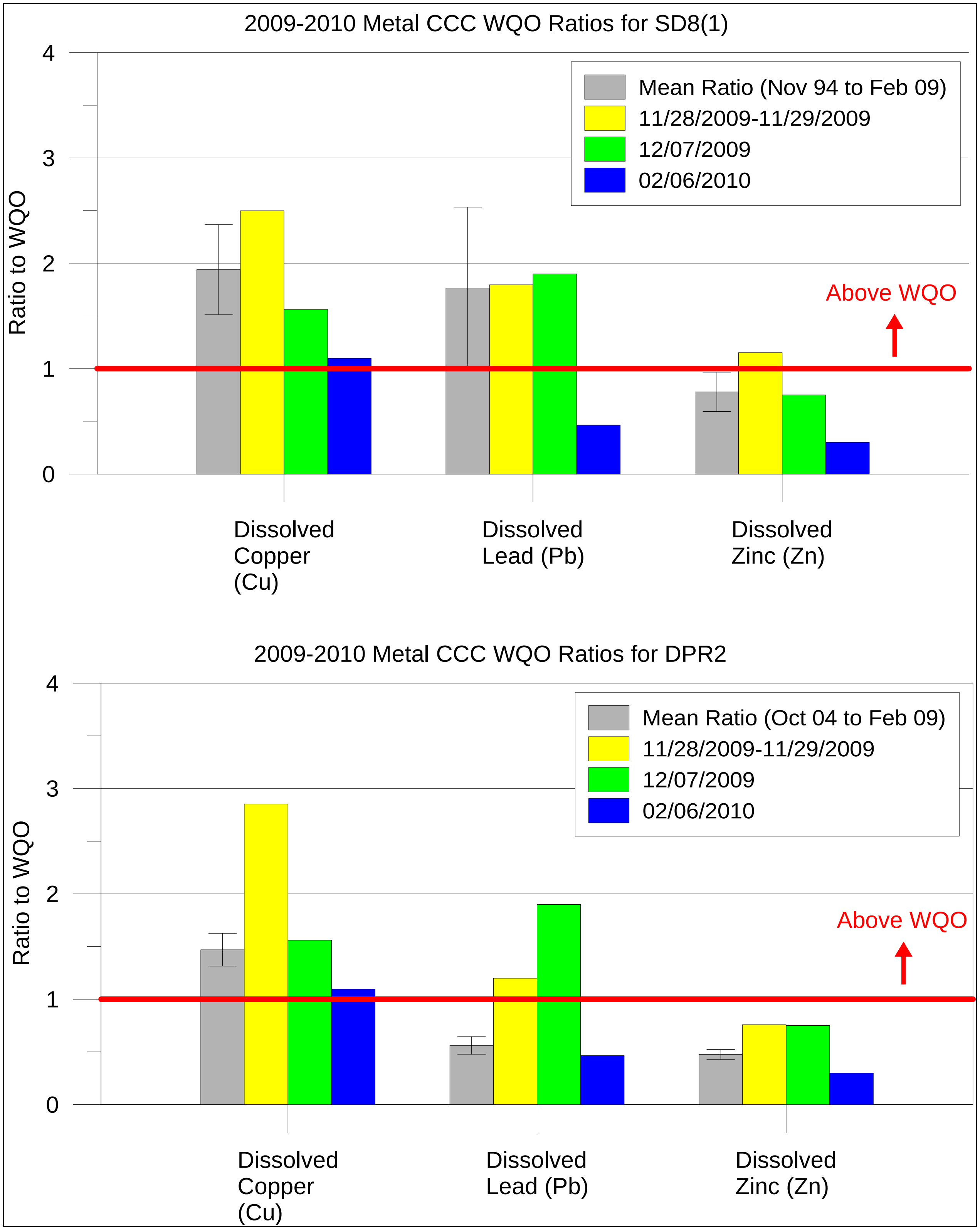
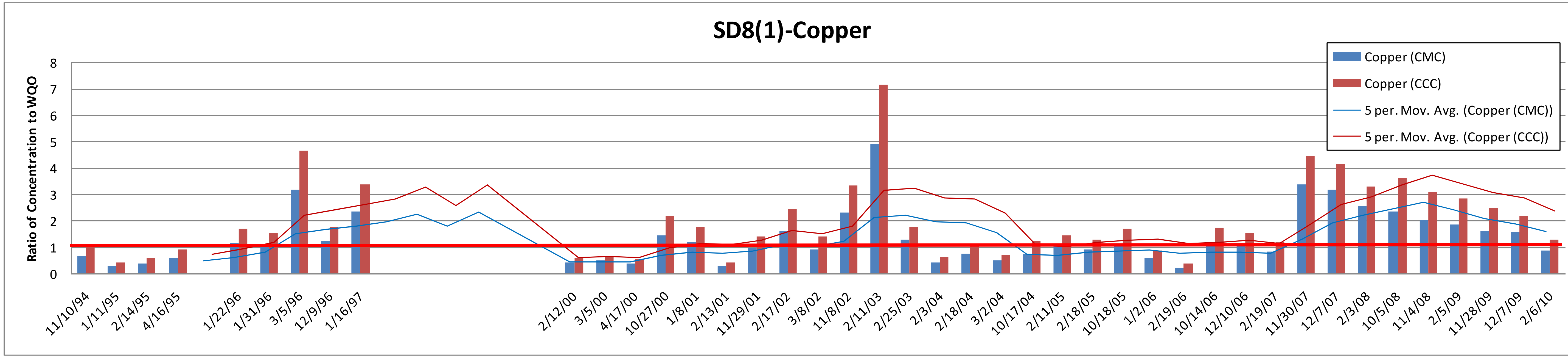



**Figure 5-5. 2009–2010 Ratio Plots for Metals Concentrations Compared to the Chronic Waste Load Allocation at SD8(1) and DPR2**



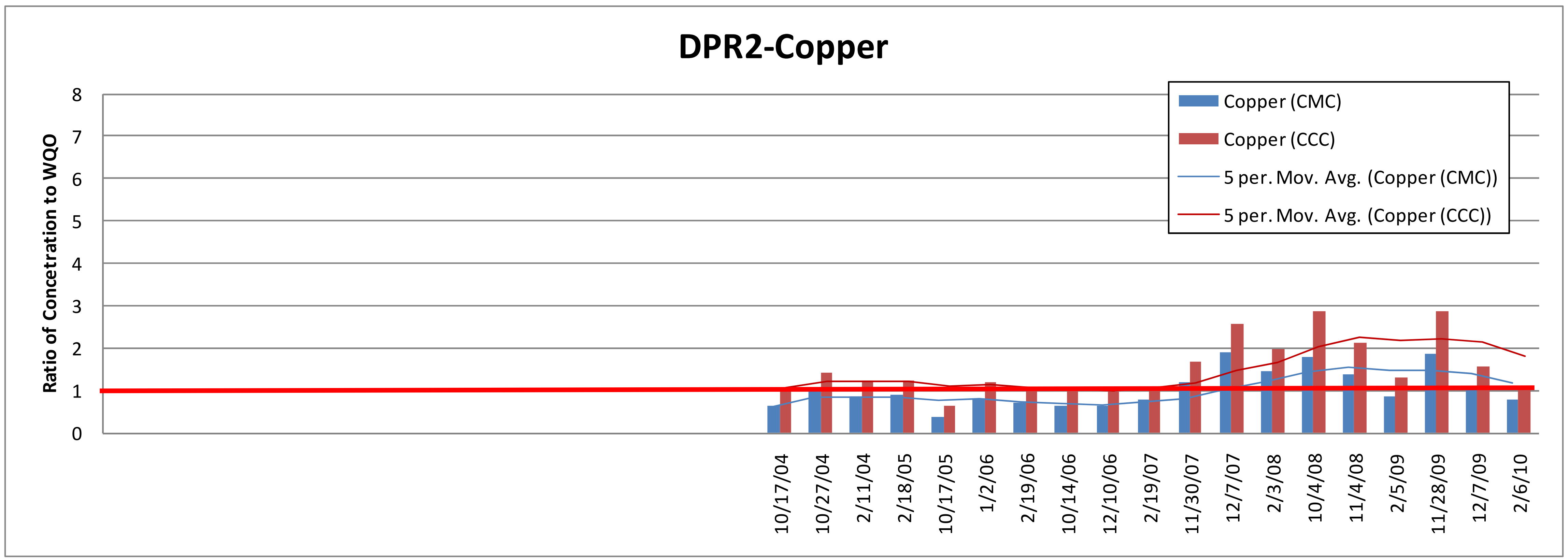
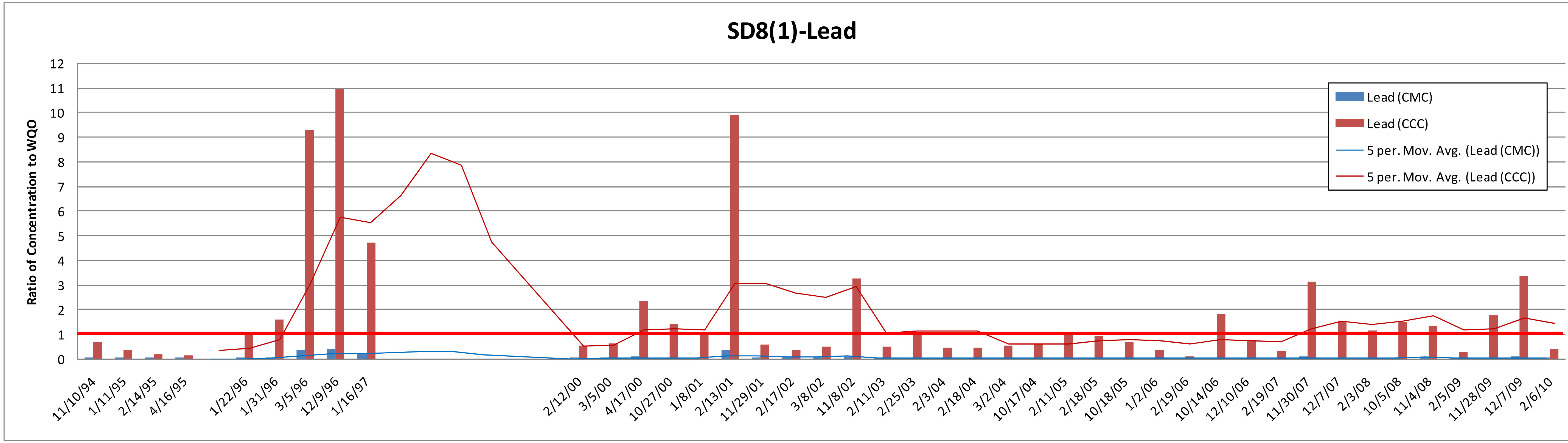




**Figure 5-6. Historical Dissolved Copper Exceedance Ratios Showing the Five-Unit Moving Average**



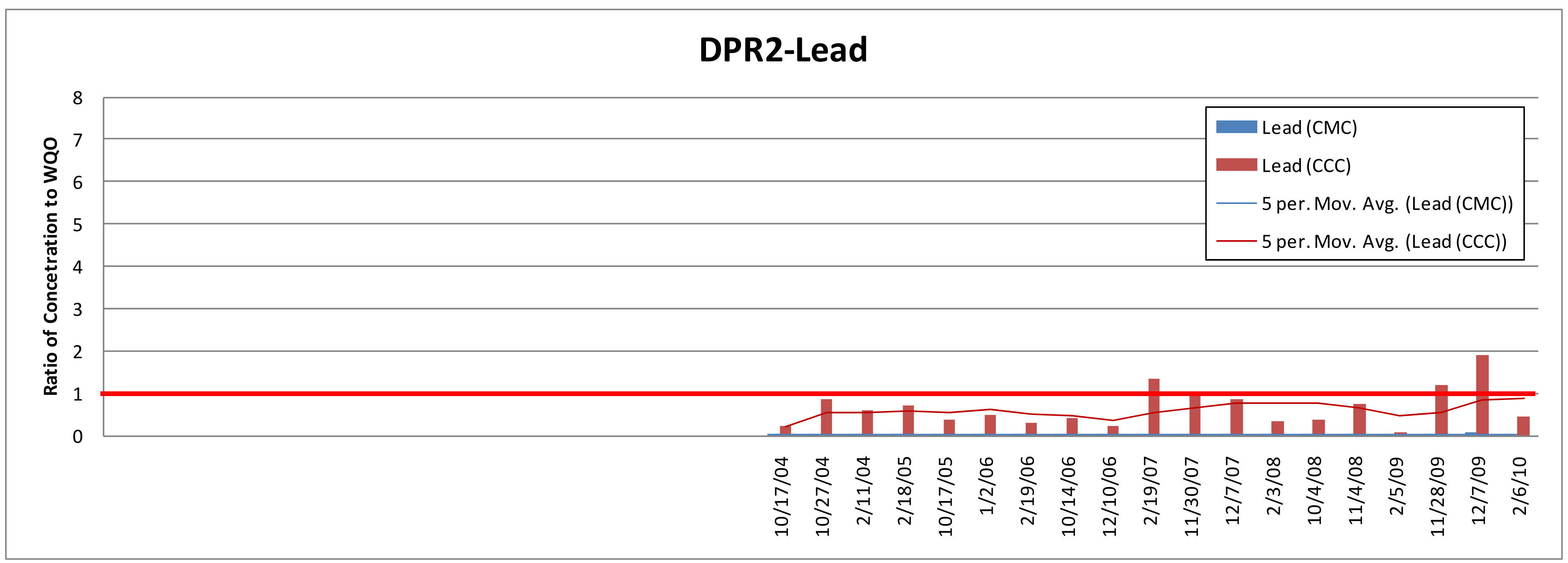
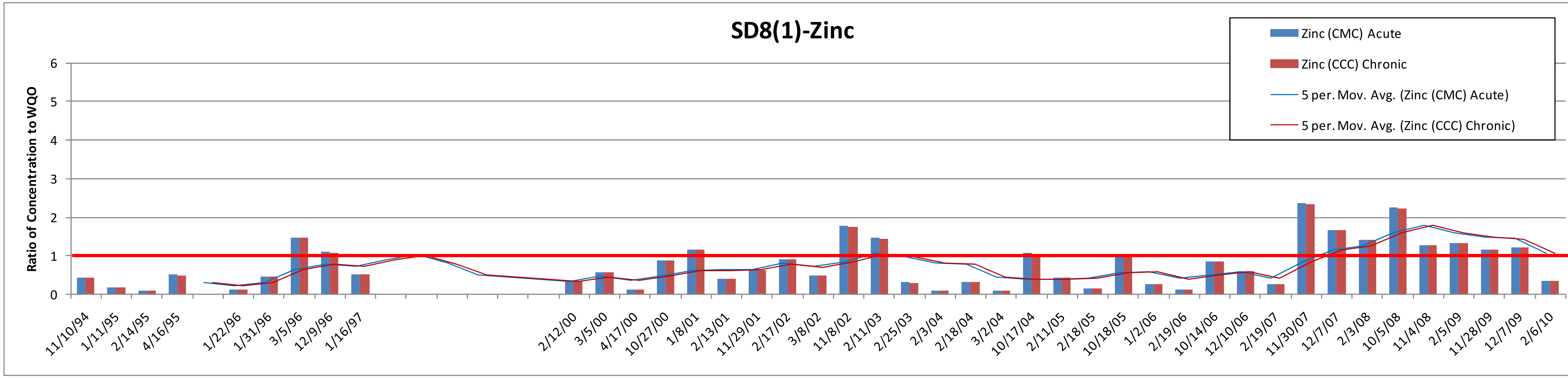




**Figure 5-7. Historical Dissolved Lead Exceedance Ratios Showing the Five-Unit Moving Average**



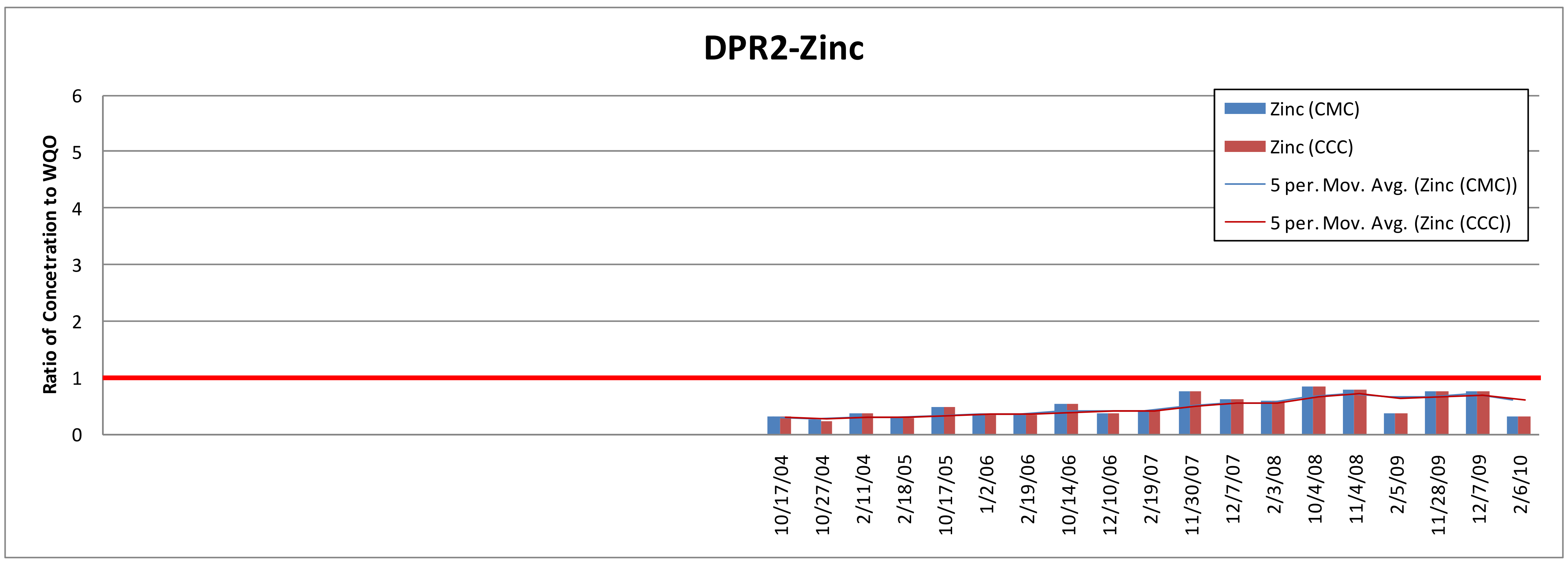




**Figure 5-8. Historical Dissolved Zinc Exceedance Ratios Showing the Five-Unit Moving Average**

**<u>Metals Trends</u>**

Mann-Kendall trend analysis was conducted using the entire record of data for SD8(1) and DPR2 separately. Similar to trend analyses for Compliance Schedule Year 1 (2008–2009 Monitoring Season), the trend analyses for the north fork (SD8(1)) indicated significantly increasing trends for total copper (p=0.006), dissolved copper (p=0.026), total zinc (p=0.002), and dissolved zinc (p=0.013). Significantly increasing trends were also noted at DPR2 for total copper (p=0.044) and total zinc (p=0.019). Trend plots for copper and zinc at SD8(1) and DPR2 are shown on Figure 5-9 and Figure 5-10, respectively. While there was a significant increasing trend noted using the entire dataset, the ratio of WLA exceedances for dissolved copper and dissolved zinc have notably decreased since November 2007 (as previously noted on Figure 5-6 and Figure 5-8).

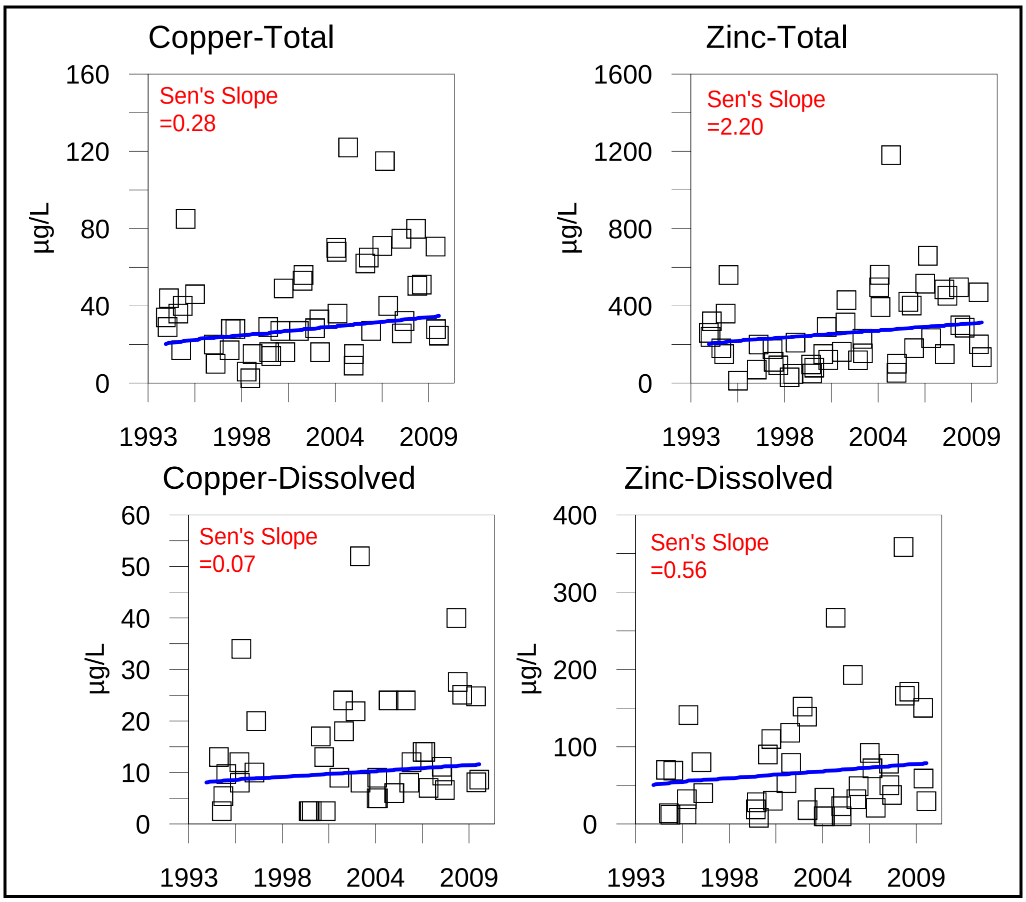



**Figure 5-9. SD8(1) Trend Plots for Total and Dissolved Copper and Zinc**

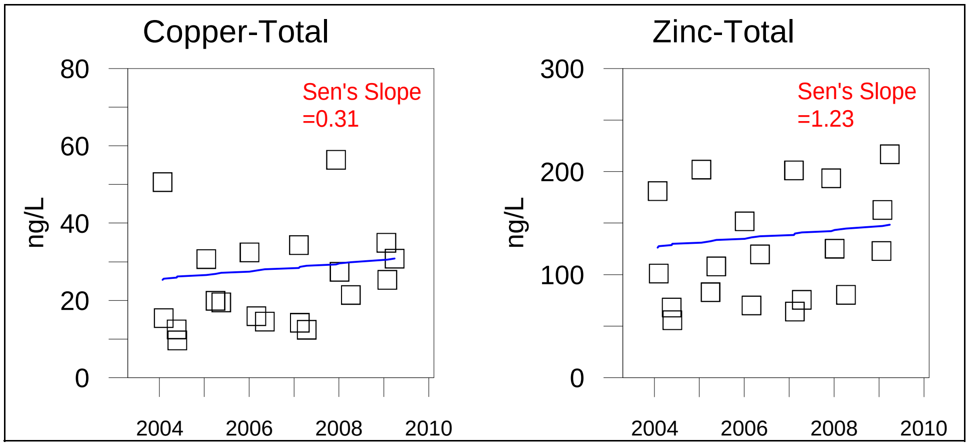



**Figure 5-10. DPR2 Trend Plots for Total Copper and Zinc**

The magnitudes of the trends for copper and zinc, as indicated by the Sen's slope value, were relatively shallow. By comparing the trends for Compliance Monitoring to monitoring conducted in 2008–2009, the data indicated that the long-term trend lines are flattening. The dissolved copper trend decreased 0.03 µg/L per year and the total copper trend decreased 0.05 µg/L per year. The magnitude of the zinc trend was greater than for copper, but had also had a greater rate of decrease over the last two years (0.34 µg/L and 0.12 µg/L per year for total and dissolved zinc, respectively).

The historical frequency of metals exceedances by Compliance Monitoring is presented in Table 5-1.

The Chollas Creek Dissolved Metals TMDL sets the numeric targets equal to the default CTR criteria of 1.0, the most current, conservative benchmark for dissolved copper, lead, and zinc in freshwater. The CTRs for dissolved copper, lead, and zinc were comprised of hardness-based equations that vary with sample hardness concentrations (Figure 5-11). The Chollas Creek Watershed is unique in that it has significantly lower hardness concentrations, and therefore lower dissolved metals criteria, than other watersheds in San Diego County. However, hardness has been shown to be less of a predictor for bioavailability of metals in urban waters. Other constituents found in urban waters (e.g., dissolved organic carbon) have been shown to reduce the bioavailability of copper in relation to predicted toxicity (Figure 5-12). The City of San Diego is currently conducting a water-effect ratio study in Chollas Creek. The purpose of the study is to develop a site specific objective to determine the actual concentrations at which dissolved copper, lead, and zinc cause toxicity in Chollas Creek waters. Final results of the study will be available in 2012.

**Table 5-1. Metals Exceedances Compared to the Total Maximum Daily Load Waste Load Allocations for Three Monitored Storm Events by Compliance Schedule Monitoring Year**

| Allowable % Exceedance of the TMDL WLAs | Compliance Monitoring Year | Monitoring Season | Dissolved Copper Exceedances (% acute / % chronic) | | Dissolved Lead Exceedances (% acute / % chronic) | | Dissolved Zinc Exceedances (% acute / % chronic) | |
|---|---|---|---|---|---|---|---|---|
| | | | SD8(1) | DPR2 | SD8(1) | DPR2 | SD8(1) | DPR2 |
| **100%** | Year 1 | 2008–2009 | 100 / 100 | 67 / 100 | 0 / 67 | 0 / 67 | 100 / 100 | 0 / 0 |
| | Year 2 | 2009–2010 | 67 / 100 | 67 / 100 | 0 / 67 | 0 / 67 | 67 / 33 | 0 / 0 |
| | Year 3 | 2010–2011 | – | – | – | – | – | – |
| | Year 4 | 2011–2012 | – | – | – | – | – | – |
| | Year 5 | 2012–2013 | – | – | – | – | – | – |
| | Year 6 | 2013–2014 | – | – | – | – | – | – |
| | Year 7 | 2014–2015 | – | – | – | – | – | – |
| | Year 8 | 2015–2016 | – | – | – | – | – | – |
| | Year 9 | 2016–2017 | – | – | – | – | – | – |
| **20%** | Year 10 | 2017–2018 | – | – | – | – | – | – |
| | Year 11 | 2018–2019 | – | – | – | – | – | – |
| | Year 12 | 2019–2020 | – | – | – | – | – | – |
| | Year 13 | 2020–2021 | – | – | – | – | – | – |
| | Year 14 | 2021–2022 | – | – | – | – | – | – |
| | Year 15 | 2022–2023 | – | – | – | – | – | – |
| | Year 16 | 2023–2024 | – | – | – | – | – | – |
| | Year 17 | 2024–2025 | – | – | – | – | – | – |
| | Year 18 | 2025–2026 | – | – | – | – | – | – |
| | Year 19 | 2026–2027 | – | – | – | – | – | – |
| **0%** | Year 20 | 2027–2028 | – | – | – | – | – | – |

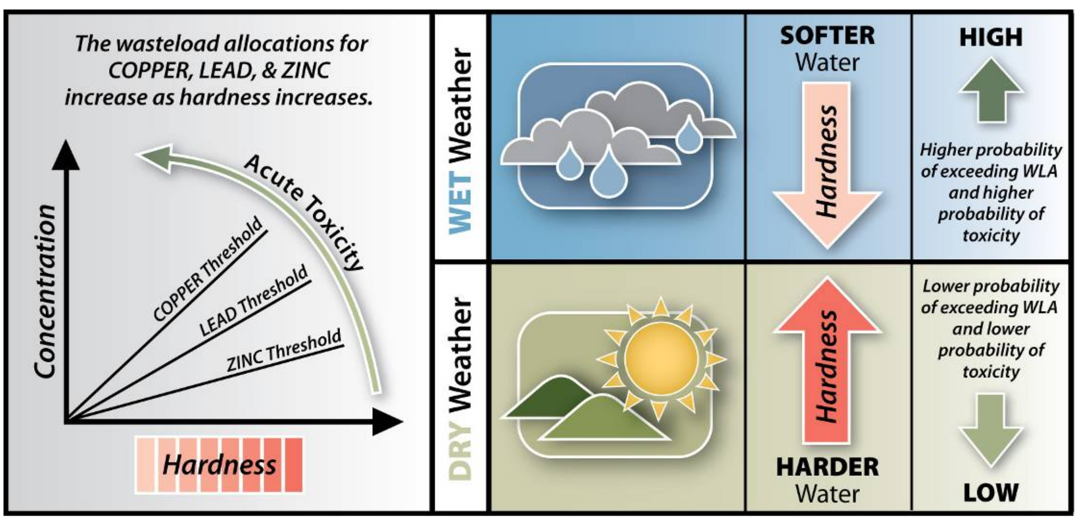
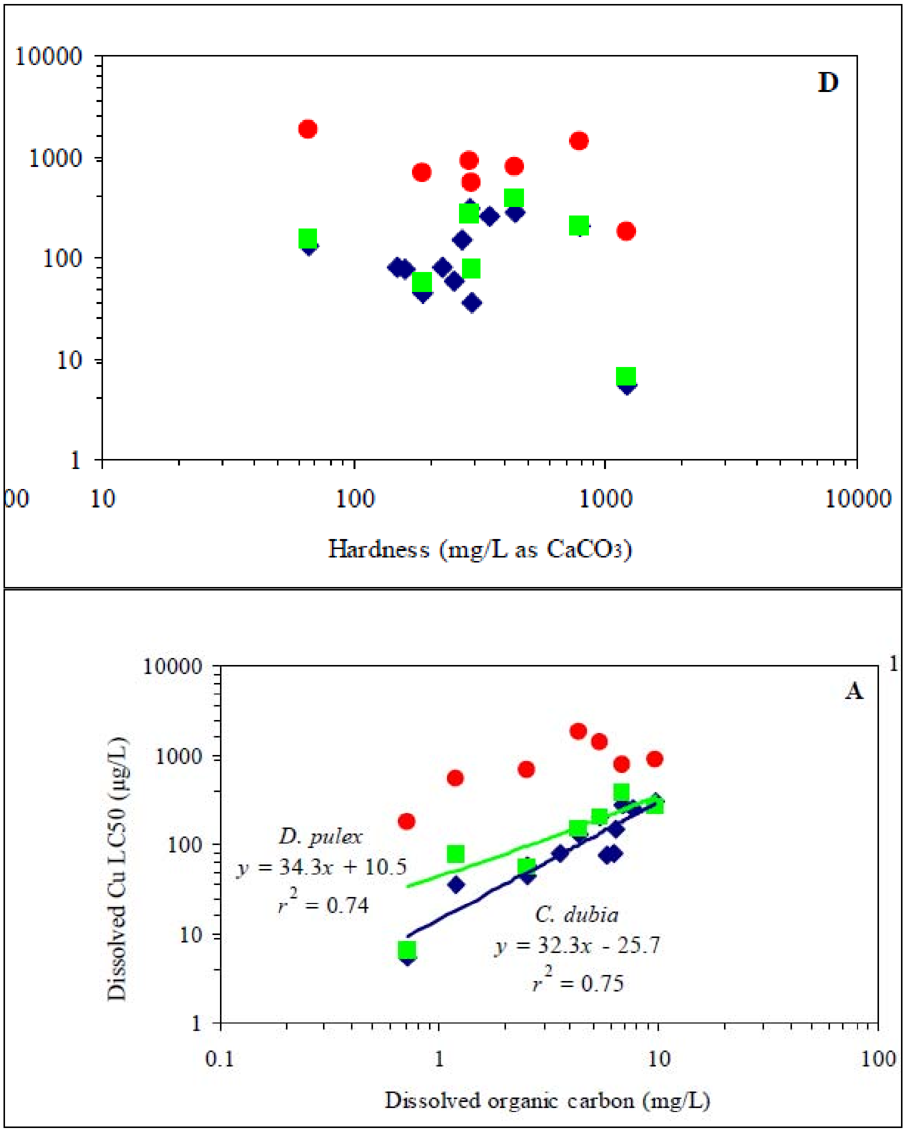



**Figure 5-11. Impact of Hardness as a Dominant Variable in the California Toxics Rule Criteria**




*C. dubia*=blue diamonds, *D. pulex*=green squares *P. promelas*=red circles
Source: Parametrix and Hydroqual, 2006.

**Figure 5-12. Dissolved Copper LC50 in Relation to Hardness (top) and Dissolved Organic Carbon (bottom) (*C. dubia* shown in blue)**

## Diazinon and Toxicity Trends

The United States Environmental Protection Agency (USEPA) implemented a nationwide ban on the retail sale of pesticides containing Diazinon on January 1, 2005. Trend analysis indicated a significant decreasing trend for SD8(1) ($p < 0.001$) and Diazinon at DPR2 ($p < 0.001$). As shown on Figure 5-13, the magnitude of this trend at DPR2 is relatively small and equal to -0.20 ng/L per year. The magnitude of decrease could not be quantified for SD8(1) due to the number of non-detects in the historical dataset (50%). The historical Diazinon concentrations and long-term decreasing trends for SD8(1) and DPR2 are shown on Figure 5-14 and Figure 5-15. As the residual supply of Diazinon becomes exhausted, Diazinon concentrations and the frequency of detection should continue to decrease. No significant trends for toxicity to *C. dubia* were observed for either site, but a review of historical data indicated that both SD8(1) and DPR2 had high rates of non-toxic results. This finding also justified the need for conducting a site specific objective for dissolved copper, lead, and zinc in Chollas Creek as toxicity was not commonly observed since Diazinon was banned and no longer detected in storm water.

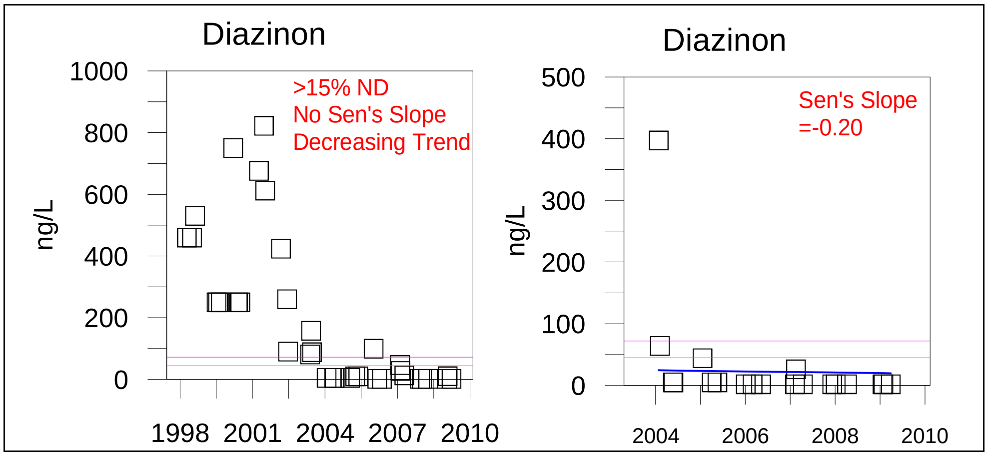



**Figure 5-13. Trend Plots for Diazinon – SD8(1) (left) and DPR2 (right)**

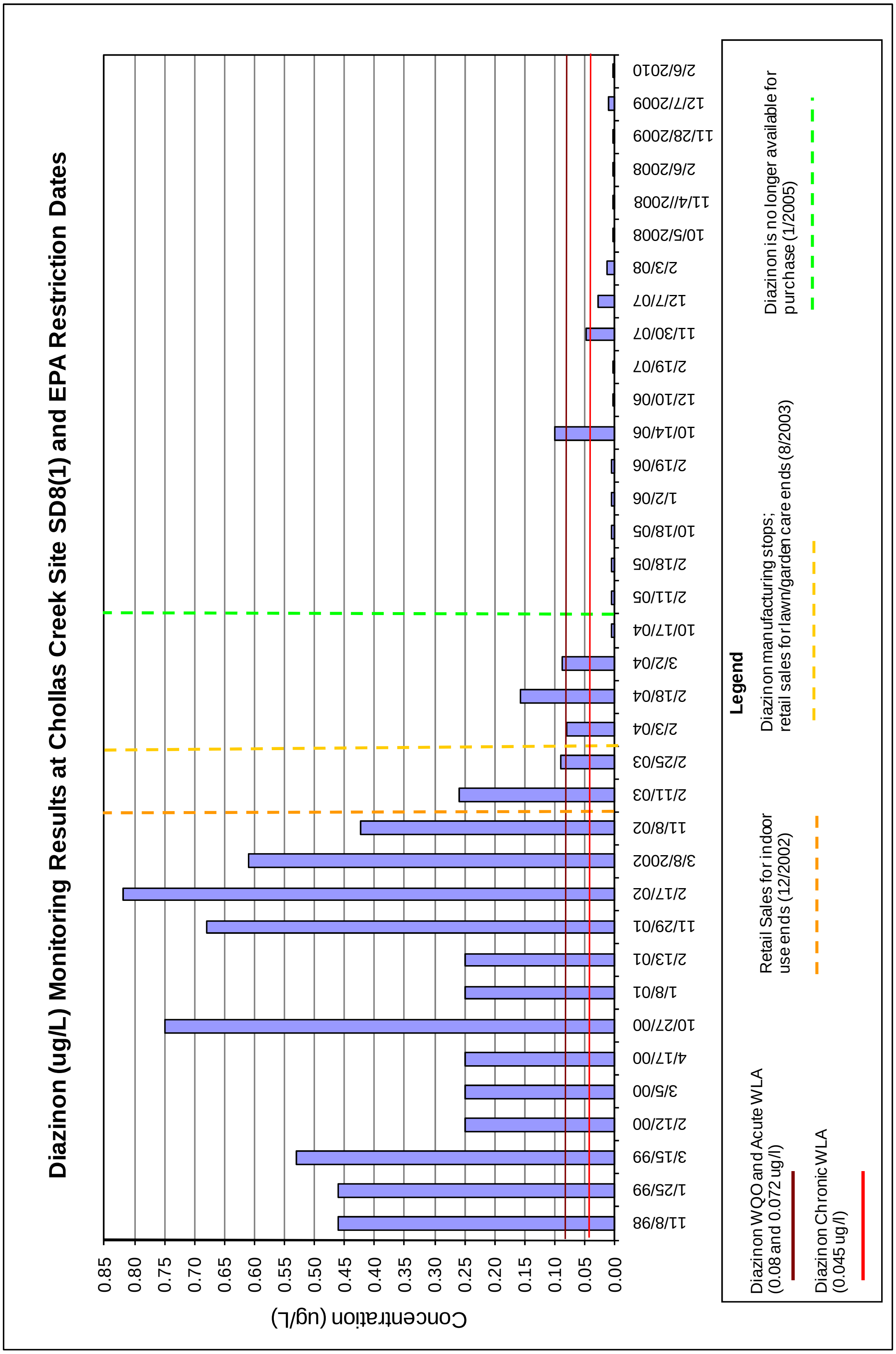



**Figure 5-14. Historical Diazinon Concentrations at SD8(1) with Restriction Dates**

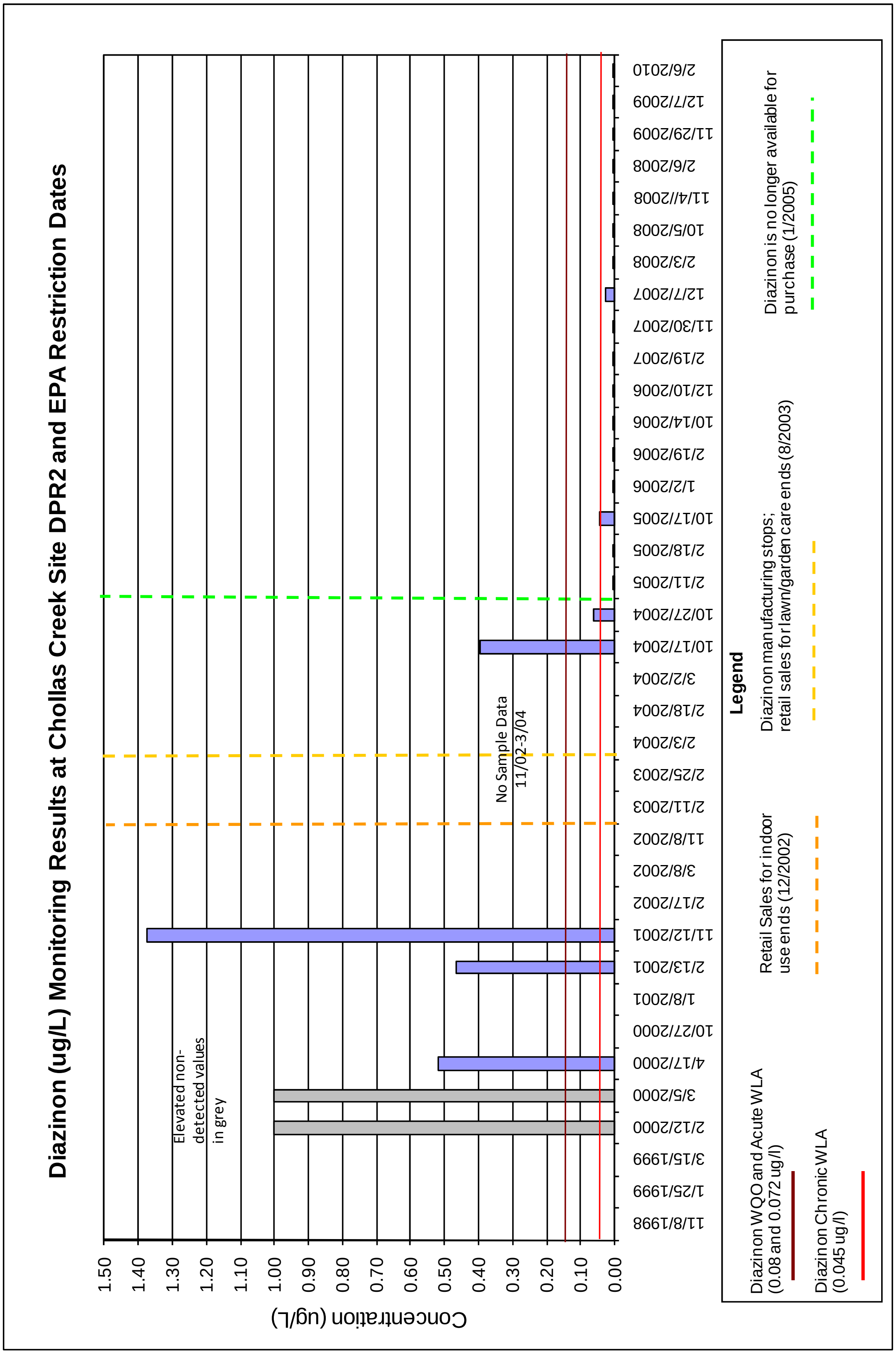



**Figure 5-15. Historical Diazinon Concentrations at DPR2 with Restriction Dates**

# 6.0 SUMMARY AND CONCLUSIONS

The Chollas Creek Dischargers conducted monitoring in accordance with the Chollas Creek Dissolved Metals TMDL (State Board Resolution No. 2008-0054 and Investigation Order No. R9-2004-0277). Monitoring was conducted November 28, 2009; December 7, 2009; and February 6, 2010; at SD8(1) and DPR2 for the following analytes:

- Total and dissolved metals (i.e., copper, lead, and zinc) and total hardness.
- Organophosphate pesticides (i.e., Diazinon, Chlorpyrifos, and Malathion).
- Toxicity to *C. dubia*.
- Chlorinated pesticides, PCBs, and PAHs.

**<u>Compliance Monitoring</u>**
The data collected for Compliance Monitoring Year 2 (2009–2010 Monitoring Season) reflect generally understood patterns for the Chollas Creek Watershed, including the following:

- Dissolved copper, lead and zinc concentrations were generally greater in the north fork (SD8(1)) than in the south fork (DPR2), and greatest during the first-flush storm event of the season.
- Dissolved lead concentrations were less than the acute WLA (0% frequency of exceedance during Compliance Schedule Year 1 and Compliance Schedule Year 2), but results above the chronic WLA were noted.
- Malathion and Diazinon were the only organophosphorus pesticides detected. Diazinon was below the acute and chronic WLA. Malathion was detected at both sites above the chronic benchmark during second storm event.
- Toxicity was not observed to the acute or chronic survival endpoint for *C. dubia*. However, reproductive toxicity to *C. dubia* was observed at SD8(1) during the first-flush storm of the season.
- PAHs and chlorinated pesticides were detected in similar concentrations in both forks of the creek. However, PCB congeners were only detected in the south fork (DPR2) during the February 6, 2010 monitoring event.

Dissolved copper concentrations at SD8(1) and DPR2 were greater than the acute WLAs for the first two storms after October 1, 2009. Dissolved copper concentrations were above the chronic WLA for all three monitored storm events. Dissolved lead was below the acute WLA for both SD8(1) and DPR2. However, dissolved lead was above the chronic WLA during the first and second storms monitored at both sites. Dissolved zinc was above the acute WLA at SD8(1) during the first two monitoring events. Dissolved zinc was below the chronic WLA during all events at DPR2 and during the February 6, 2010 storm at SD8(1).

Like the storm-specific data, the Mann-Kendall trend analyses indicated significantly increasing trends for total and dissolved copper and total and dissolved zinc in the north fork of Chollas Creek (SD8(1)). When compared to historical data, increasing trends were relatively shallow and have flattened over time. Exceedance ratios have steadily decreased at SD8(1) since 2007. Significantly increasing trends were noted for total copper and total zinc at DPR2.

While the organophosphate pesticides Diazinon and Malathion were detected during the 2009–2010 Monitoring Season, concentrations were generally low. Diazinon was below the chronic WLA during all events at both sites. Significantly decreasing trends were observed for Diazinon in both the north fork and south fork. For Diazinon, non-detect results were frequently noted. As the residual supply of Diazinon becomes exhausted due to the USEPA ban on Diazinon, concentrations and the frequency of detection in Chollas Creek should continue to decrease.

There was only one instance of reproductive toxicity to *C. dubia* noted at SD8(1), during the first-flush storm event. This was the first storm event following approximately 279 dry days without significant rainfall. Pollutant buildup during this long dry weather period may have contributed to the toxic effects observed during the first flush storm event.

**Recommendations**

Based on the TMDL compliance monitoring results from the 2009–2010 Monitoring Season, the following program modifications are recommended:

- Continue monitoring to evaluate compliance with the Chollas Creek Diazinon and Dissolved Copper, Lead, and Zinc TMDLs and to assess trends in monitoring data.
- Evaluate the results from the City of San Diego Water-Effect Ratio study, a final report is anticipated in 2012.
- Future monitoring should include the additional analytes necessary to evaluate metals toxicity using the biotic ligand model. This data will provide additional support to the Water-Effect Ratio study results.
- Re-evaluate the dissolved lead TMDL WLA in the anticipated release of the draft USEPA revised lead criteria.

**Ongoing TMDL Implementation**

The Chollas Creek TMDL Implementation Plan was specifically prepared in response to Resolution No. R9-2007-0043 in which the Regional Board incorporated the TMDL for dissolved copper, lead, and zinc into the Basin Plan. The Implementation Plan used an iterative and adaptive management strategy for identifying, planning, implementing, and assessing BMPs for the Chollas Creek Watershed over the 20-year compliance schedule. The Implementation Plan was submitted to the Regional Board on October 21, 2009. The seven named TMDL Dischargers, which included the five Chollas Creek Watershed Municipal Copermittees, the US Navy, and Caltrans, will use the Implementation Plan as a framework for ongoing compliance.

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